SCIENTIFIC AMERICAN SUPPLEMENT. No. 1256

Copyright, 1900, by Munn & Co.

Scientific American, established 1845.
Scientific American Supplement. Vol. XLIX. No. 1256.

NEW YORK, JANUARY 27, 1900.

Scientific American Supplement. $5 a year
Scientific American and Supplement. $7 a year.

TOWING CANAL-BOATS BY ELECTRICITY.

THE well-known German firm of Siemens and Halske, says the Illustrirte Zeitung, have established an experimental electrical towing system three-quarters of a mile in length along the Finow Canal, near Eberswalde. Experiments were made with the Lamb and Köttgen systems.

The Lamb system has been used in the United States and attracted no little attention at the time it was first introduced. The boats are towed by a cable passed around an elliptically-grooved wheel on a car or locomotive driven by an electric motor. The towing-cable contains insulated wires and is rigidly attached to an eye-bolt, just below the point of insulation on the hanging frame. The bite of the rope is connected with a clamp made of nonconducting material. The socket of the clamp, and the pin by which it is engaged, containing the wires leading to the reversing switch, are made irregular in shape, so that corresponding wires are obliged to come in contact when the clamp is connected. The towing-rope is secured to the sampson-post, leaving the end of the rope free. The wires are connected as desired with the respective wires of the rheostat by the clamp. When two boats coming in opposite directions approach each other, motors are stopped and cables disconnected. The boats exchange cables and motors and proceed on their way. An extra cable would obviate the necessity of exchanging motors.

Lamb's system did not prove as successful as that of his rival. In Köttgen's method of towing, instead of an overhead cable, a narrow-gage railway is employed, upon which a small, electric, two-ton locomotive runs. The motor is connected with an overhead feed-wire by a trolley-wheel, which runs over instead of under the wire. The dead weight of the locomotive is supported only by one rail, the other rail serving merely as a guide. If the road be macadamized, the second rail can be dispensed with, in which case two of the wheels are inclosed in a casing and the remaining two wheels permitted to run upon the single rail. The driver's seat is arranged at one side of the locomotive, within easy reach of the starting and regulating apparatus and the brakes. The towing-hawser is secured to the locomotive about three feet above the rail, and runs to a mast on the barge. With a speed of two to three miles per hour, the locomotive can pull a load of 1,300 pounds. The power developed is sufficient to tow three fully laden or two laden and two empty boats.

THE KÖTTGEN ELECTRIC CANAL-BOAT LOCOMOTIVE.

COLOR IMPRESSIONS.*

IT is now well known that the perception of color varies very greatly among men and also among animals. In fact, as Schopenhauer remarked, color is merely a subjective impression, originating in the brain. A normal human being, i. e., one constituted after the majority of his kind, distinguishes not merely light and dark shades, but an immense number of different hues. A convenient, but not altogether complete, collection of them can be obtained by passing a beam of sunlight through a prism, and receiving the refracted rays on a white screen at a little distance from the prism. A colored band is produced upon the screen. This is the so-called solar spectrum, and if it is carefully examined it will easily be seen that every part of the spectrum is of a different color, but that neighboring parts closely resemble one another. As we have not words for all the various gradations, the course adopted is to give separate names to about half a dozen of the color regions, and denote the intermediate hues by combinations of these names. The color impressions to which we give names are red, orange, yellow, green, blue and violet. If red and violet light enter the eye together, a color impression is received which cannot be obtained from the spectrum, that of purple. If we reckon this, we have seven fundamental color-types—red, orange, yellow, green, blue, violet, purple.

In popular language, white and black are also taken as colors. But they are not really so. We

* Abstracted by Invention (November 4) from the Maler-Zeitung.

THE KÖTTGEN SYSTEM OF ELECTRICAL TOWING ON THE FINOW CANAL, GERMANY.

receive the impression of white when all the colors act upon the eye simultaneously, so that no one preponderates, and the impression of black in the absence of light. Hence black is either absolute darkness or a body which reflects no light. Gray is a white deficient in volume of light, and is thus intermediate between white and black. As has just been said, the seven names do not indicate actual distinct colors, but rather color regions. The word yellow, for example, includes a whole set of shades, among which may be mentioned sulphur-yellow, citron-yellow, egg-yellow, etc., as well as brownish-yellow, slightly reddish-yellow, greenish-yellow and many others. All of them can be named by combining together two or more of the primary names. This is the case even with a few of them on which usage has conferred special names; brown, for example, is a very dark yellow or orange, reddish-brown a dark red, flesh color a whitish purple, etc.

The seven fundamentals have two noteworthy properties. In the first place, they follow each other in a definite order, without, however, being separated by any sharp boundary lines. The order is orange, yellow, green, blue, violet, purple, red. In the second place, they may be described by three names only, red, yellow and blue, denoting some of them by combinations of these names. The order will then read, reddish-yellow, yellow, yellowish-blue, blue, bluish-red, reddish-violet, red. Orange, green, violet and purple are secondary colors. These facts indicate that there are only three distinct color impressions, and these are denoted with sufficient accuracy by the words red, yellow and blue. Helmholtz has, however, shown that, more strictly speaking, red, yellowish-green and violet-blue are the fundamental colors. The physical explanation of the threefold division of color is that the normal eye contains three color-appreciating organs. If one is excited, the impression of red is created, if another that of violet-blue, while stimulation of the third causes a sensation of yellowish-green. Red light excites the first, and yellow stimulates the first and third, thereby producing a sensation intermediate between those of red and yellowish-green. Yellowish-green light affects the third, and green or blue light the second and third, producing the impression of green when the third is the more strongly affected and of yellow when the second is more stimulated. Bluish-violet impresses the second, while a mixture of red and violet excites both first and second, so as to produce the impression which we designate purple. When all three organs are affected at the same time, the impression caused is that of white. This may happen when light of all colors enters the eye, but it also occurs with the so-called complementary colors when they enter the eye together. Such complementary combinations are red and bluish-green, and yellow and blue. In the former case the red light affects the first organ, and green affects the other two, while in the second case the yellow light acts on organs one and three and blue on two and three. In each case all the three are affected.

MECHANICAL TRACTION ON CANALS.

ALTHOUGH W. Symington's first experiments to determine the possibility of moving vessels by steam power took place on a canal, they were not necessarily made with a view to canal traction only. Nevertheless, at a very early date in the history of the steam engine, the idea of using it instead of horses for working canal traffic occurred to some of the eminent men who took so great a part in promoting the industrial prosperity of this country a century ago.

Of these, apparently the first was the Duke of Bridgwater, who had trials made of a steam paddle-boat on his canal near Worsley, some time between 1796 and 1799. A Captain Shanks, R.N., from Deptford, built her at Worsley, under the Duke's supervision. She managed to tow eight coal boats, of 25 tons each, to Manchester, at the rate of a little more than a mile an hour, but the paddles injured the bottom of the canal and threw the water on the bank, and she was given up. The people called the vessel "Buonaparte," and regarded her as a most strange and unearthly invention. About May or June, 1797, a boat heavily laden with copper slag went from Newton Common to St. Helens, on the Sankey Canal, "without the aid of haulers or rowers, the oars performing eighteen strokes a minute by the application of steam only"! The return journey, ten miles, was also made by steam. Possibly these "oars" were shovel-like blades set in a central hub, or it may have been intended to imitate rowing. Haulers were the gangs of men who then, quite as often as horses, painfully dragged the canal boats along at a mile or two an hour. The later experiments of Symington were intended expressly to ascertain whether steam power could profitably supersede that of men or horses on canals. These were carried on by the Forth and Clyde Canal Company in 1801 and 1802, at the instance of Lord Dundas, the governor or chairman. They issued in the construction of the "Charlotte Dundas," a stern-wheel steamer having a nearly horizontal cylinder, 22 by 48, on the top of the boiler, and driving a light cranked shaft which geared in with the axle of the paddle wheel. This wheel was in a transverse orifice near the stern, not projecting beyond it, as with modern light-draught stern wheel steamers. Two rudders had to be provided, one on each side of the wheel, and worked simultaneously from the bow. Over the bows were stampers, three on each side, raised in succession by levers worked tilt-hammer fashion by stops on the sides of the paddle-wheel, for breaking the ice in winter time. At trials of this boat in December, 1801, three 60 ton boats were hauled, and in April, 1802, two others, the "Active" and the "Euphemia," of Grangemouth, were towed 19½ miles to Port Dundas against a wind so strong that no other vessels could make head against it. Although the experiments were satisfactory, some influential proprietors feared it would injure the canal banks, and in consequence the "Charlotte Dundas" was laid up in a creek and lay rotting there for years. Without a load she did about six miles an hour. In the Journal of the Royal Institution for 1802 there is a curious view of a model of this vessel, shown to the Institution by Symington himself at the request of Lord Dundas. It shows the ice-breaking arrangement over each bow. The inventor estimated that a boat of the kind, doing twelve horses' work, would move at 2½ miles an hour, and cost £800 or £900. The Duke of Bridgwater was so satisfied with the results she gave that he ordered eight like her for his own canal, but his death put an end to the project, and they were not built. The specification of Symington's patent for an engine like that of the "Charlotte Dundas," No. 2544, 1801, is chiefly remarkable as showing the hitherto indispensable beam motion done away with and direct action substituted.

For a long time after this little or nothing was heard of steam traction on canals. It was not, of course, till 1812 or 1813, that steam navigation really proved a practical success on rivers, and for canals the difficulty of the wash of stern-wheel boats, and of getting sufficient power into side-wheel vessels narrow enough for the locks, remained a hopeless problem. Most of the principal lines of navigation were prosperous enough to have little stimulus to make costly experiments or innovations, and it was not until the railway era was beginning to loom in the future that their proprietors began to stir themselves. It was again on the Forth and Clyde Canal that the question was carried to a solution. This canal had locks 20 feet wide—much wider than usual—and was therefore especially suited for steam vessels. It was, in fact, according to the standard of those days, a ship canal. In 1828, Mr. Murray, inspector of works on the canal, finding that one of the smaller Clyde steamers, named "Cupid," could pass the locks, had a series of trials made with her, under the direction of Mr. J. Watt, son of the great James Watt, of Soho. These trials showed at equal speeds a steamer made no more wash than a horse-drawn vessel, nor any objectionable amount up to four or five miles an hour, while the cost of working was about one-half. The company then fitted a heavy old iron passage boat with a stern wheel placed in a rectangular trough cut out of the stern, closed on each side and in front. The wheel proved too much boxed in, the vessel was very slow in the dead water of the canal, though she could do six or seven miles an hour in the tideway between Grangemouth and Alloa. The "Cyclops" carried about 40 tons of cargo, which had to be as far forward as possible, otherwise the paddle-wheel was practically drowned. The length of this boat was 68 feet; breadth, 15½ feet or 16 feet; depth, 6 feet or 7 feet. It led to the building of the "Lord Dundas," an iron passenger boat with plating only $\frac{1}{16}$ inch thick, about the autumn of 1831. She only drew 16 inches of water, and was really an adaptation of Mr. Houston's long light passage boats mentioned in The Engineer of July 22, 1898. She was 68 feet long, 11½ feet beam, 4½ feet deep, and weighed only 7 tons 16 cwt. There were two paddle-wheels in a long hollow space in the center—an arrangement which gave no better speed than the "Cyclops." A third iron steamer, called the "Manchester," was made by Fairbairn for the Forth and Clyde Canal Company in 1831. She was about the same size as the "Cyclops," but had two narrow paddle-wheels working under the quarters, 3 feet wide and 11 feet in diameter. A 24 horse power engine "on the locomotive principle," with cylinders on the top of the boiler, drove these wheels. Fifty tons of cargo could be carried, but all three boats broke down so frequently that they came dearer than horse power, and were given up. Nor could they equal the nine miles an hour obtained by horses with the light passage boats on the Paisley Canal.

A double-hulled steamer was built at Liverpool for the canal and river service between Dublin and Limerick, having the paddle-wheel between the two hulls. Stern wheels, however, were very popular with engineers, as saving room, and in 1826 a vessel of this kind, whose wheel would lift up on entering a lock, went from London to Birmingham. She carried 30 tons of goods, the machinery weighing four tons. Steam was raised by the "patent duplex generators" —a system in which water was injected, in very small quantities at a time, into a closed vessel between whose inner and outer shells the fire circulated. The Patent Steam Canal Company, which was attempted to be formed in 1825, had driven a 70-foot barge at ten miles an hour in the Thames, the 4 horse power engine having four "steam chambers" 6 feet long, but only 6 inches in diameter. A small steamer went from London to Manchester in 1828, the invention of David Gordon, one of the early steam-carriage men. She towed a barge loaded with timber through a long tunnel, the voyage being undertaken solely to ascertain if steam could be used without damaging the banks—a fact which was satisfactorily proved.

On the Regent's Canal, in London, steam haulage by means of a chain has been used ever since 1825. In that year Capt. Samuel Brown, builder of the chain pier at Brighton, tried this method, the drum having pegs round its circumference to engage with the links. On what part of the canal this took place is not stated, but in 1828 a similar system was in use in the Islington Tunnel. The boat was nearly the width of the tunnel, which is 17 feet, and had a 4 horse power high-pressure engine, with a horizontal cylinder. The chain made two or three turns round an iron roller, and passed in and out, head and stern, through a wrought iron tube. Coke was burnt, with the curious result that the heat and sulphur were almost insufferable at the head of the boat, but scarcely noticeable at the stern. It was supposed the boat did not pay, for it was discontinued soon after, and the old system of "legging" through resorted to, but the chain traction was again in use through Islington Tunnel within a few years and indeed is still. In 1828 the boat took two Thames barges through in fifteen minutes, the distance being about 900 yards, but at present about twice that time is occupied, whatever the load. The boat now in use is apparently very old, nearly as wide as the tunnel, and has a semicular iron covering over the machinery and boiler. It makes a slight clanking noise as it crawls along, and is locally known as Noah's Ark. It goes no further than the tunnel in either direction.

In August, 1834, the enterprising Forth and Clyde Canal Company tried chain traction, with a twin boat, in the mid-space of which a grooved wheel received the chain and passed it out behind. Steering was not found to be unfavorably affected, and a speed of as much as 8¾ miles an hour was said to have been attained. The intention was to lay a chain the whole length of the canal, but we cannot state whether this was ever done, or the system kept up even partially for any length of time. The company, however, was then engaged in a fruitless effort to prove the superiority of canals to railways, in which it naturally got worsted, although it is nevertheless certain that in some cases the canal has advantages over its rival. It even tried towing from the bank with a road locomotive or steam-carriage of some kind, following it up, in 1839, by laying a short line of railway for the same purpose. An engine called Victoria, built by W. Dodds, was used, the line having stone block sleepers. A passenger boat was drawn at nearly 20 miles an hour, and eight cargo vessels, holding 364 tons, at 2½ miles an hour, the engine working at only a quarter of its power. Twenty horses could only pull them at 1½ miles, and at much greater cost. The line was near lock No. 16. Why the experiment was not carried further does not appear, but it will be recollected that a similar one on the Shropshire Union Canal a few years ago was also given up.

Even rowing by steam seems to have been tried. A boat having long levers, fitted at the bottom with hinged blades which folded back during the return stroke, was tried on the Regent's Canal, January 28, 1835. The stroke of the rod which worked the levers was about 3 feet, the number of strokes being estimated at 60 per minute. This seems very unlikely, but, anyhow, the boat could only do three miles an hour without a load.

In the summer of 1838 the ingenious form of propeller invented by the famous John Ericsson, patented by him—No. 7149—two years before, was tried on the Paddington Canal. The boat went down to Bull's Bridge at five miles an hour, from there to Brentford by the Grand Junction, and back by the Thames, running the 13 miles of river in 100 minutes. The vessel was an ordinary canal barge, called the "Novelty," belonging to Robins, Mills & Co., carriers. The boiler was of peculiar construction, designed by Ericsson; it was 5 feet 10 inches long. The engine had two cylinders, either 12×14 or 12×10, making seventy revolutions per minute with 30 pounds steam. At least one voyage from London to Manchester was made, the boat carrying 10 or 12 tons of goods, and doing eight miles an hour under favorable circumstances. She was also tested on the Bridgwater Canal, between Manchester and Altrincham, but could not, or was not allowed to, exceed five miles an hour. Ericsson's system combined paddle and screw action, there being two submerged transverse paddle-wheels, one in front of the other, in the position where a screw is now placed. These revolved in different directions and at different speeds, the double movement being effected by two shafts turning one within the other. The outer wheel moved faster, and had its blades inclined inward toward the vessel. If this wheel revolved to the left, as seen from the deck, the boat moved forward. The crank shanks were coupled together, the long topmost one driving the outer wheel, the short lower shaft having spur gear working the larger outside axle, which revolved round the other and carried the inner wheel. Eight shovel-like blades constituted each paddle-wheel, bound together at the periphery for strength, and held by a perpendicular stay outside the rudder. A much larger iron tugboat on Ericsson's system was built soon after the above trial by Laird, of Birkenhead, and called the "R. F. Stockton." Early in 1839 she went to her destination, the Delaware and Raritan Canal in New Jersey, after towing a vessel of 650 tons against the flood tide in the Thames at over six miles an hour. In this year Ericsson also built a screw propeller vessel, to be used for passenger traffic on the Ashby-de-la-Zouch Canal in Leicestershire. She was named the "Enterprise," was about 70 feet long, 7 feet beam, and 14 horse power. Where the water was sufficiently wide and deep she could do nine or ten miles an hour, but did not pay. She was then put to towing coal barges on the Trent and Mersey Canal, very successfully, until the railways abstracted all the traffic.

In July, 1834, an iron tug with screw propellers was tried on the Union Canal in Scotland. The engines were "on the upright principle," and were built by W. Napier, of Glasgow. The screws were on each side of the bow, and driven at a high speed by spur gearing, one wheel having iron, the other wooden teeth. Six large barges, deeply laden, were attached to each other by rods having a parallel motion, all being controlled by a steersman on the steamer, and moving along at a steady and uniform pace.

During 1843 a Mr. H. Davies constructed a number of towing boats fitted with his "disk engine" for canal service between Wolverhampton and Ellesmere Port, about seventy miles. Two trains of six or eight boats each left the termini daily, carrying on the average about 100 tons of merchandise, at the expense of less than ½ cwt. of coal per mile. Only three men accompanied each convoy. It was estimated that an equal service with horses would require six horses to every train, besides relays, and twenty-four men to drive them and steer the boats.

A curious form of submerged horizontal propeller or paddle-wheel, invented by Capt. W. H. Taylor, was tried on the Regent's and Grand Junction Canals in the summer of 1845. On each side of the tug boat, at about mid-length, was a recess containing the wheel, the blades projecting slightly outside the vessel. Above and below the wheels were compartments; by the top one the water flowed down into the wheel, and was supposed to escape by the lower. The boat was said to do four miles an hour without the least sign as to how it was moved, but the water access and egress were probably not free enough; a fault which ruined many early types of boat propellers.

Another curious idea was that of Mr. John Kibble, of Glasgow, which he patented (No. 9,918) in 1843, and tried in Scotland a little later. Two large smooth tired wheels on each side of the boat, coupled by outside rods like those of a locomotive, carried an endless belt of iron links, fitted with float boards at frequent intervals. The wheels could be forced apart to tighten the chain. For some reason or other the plan was found too expensive for practical use. A Mr. Smith, of Deanston, tried in the Forth and Clyde Canal, about 1848, a paddle-wheel projecting through the bottom of the boat, and walking, as it were, on the bed of the canal. This brilliant notion, it is unnecessary to say, proved an utter failure.

In 1846 Capt. Beadon's "warping system" was given a trial in the Regent's Canal. A flat-bottomed boat carried an engine driving two rollers or drums, one at each end of the vessel, by means of a chain passing over a grooved wheel on the outside of the drum. The rope came in, or ran out, at the opposite end of the drum, on alternate sides of the boat, to keep her straight, and was fixed at one end only. It was, therefore, wound in upon the drum till there was no more

to wind, when a fresh section of rope was attached to the other drum and the process recommenced. Meanwhile, of course, the first rope or chain was detached where the second began, and paid out behind for the next boat.

There is a view of this boat in The Mechanics' Magazine of August 29, 1846. Some of the trials took place in Maida-hill Tunnel, which is 370 yards in length, and passes under the Edgeware Road. A train of barges, carrying 128 tons of coal, was worked through at three miles an hour, which was all that the great resistance of the sides of the tunnel to the escape of the water would permit. More than a year later, toward the end of 1847, this boat was working on the Bridgwater Canal, between Runcorn and Preston Brook. One end of the rope was made fast at the destination, and wound in upon the barrel. Arriving at, say, Runcorn, the other rope and drum would be used for the return journey, the full reel being put out of gear, and allowed to unwind as the boat went along. The distance of about five and one-half miles could be done in two hours, working six loaded barges, equal in all to 250 tons burden. The plan seems inferior to that of winding on a chain or rope fixed at each end, as the boat would be greatly down by the head when one reel was full and the other empty, besides the need of two ropes instead of one.

A very extraordinary system of canal traction was tried on the Gloucester and Berkeley Ship Canal in 1850. A continuous flexible rail or bar was fixed over the surface of the water, and passed between a pair of rollers driven by a steam engine on board a small boat. The engine was powerful enough to tow a brig of 350 tons against the wind at a walking pace, and also took ordinary canal boats at six miles an hour, the tide seeming to make little difference, on only 25 pounds of coal per hour.

About this time steam power was applied on the Kennet and Avon Canal by Capt. G. F. Morrice, R.N., the traffic manager. He had an iron vessel built, 47 feet long, 9 feet beam, and 5 feet depth of hold, fitted with Jones' patent "Cambrian" engine and Griffiths' screw propeller. The latter had a large spherical center, from which sprang blades gradually tapering to their outer extremities. The boat answered well, and was also tried on various parts of the river Thames, both in the tideway and above it. The Kennet and Avon barges were mostly 70 feet long, 13½ feet wide, and carried 50 to 60 tons on a draught of 44 inches to 48 inches.

There seems to have been no end to the ingenuity of the inventors of various methods of steam canal traction, and it was a pity, on all accounts, that economic causes were stronger than they. In November, 1852, a curious combination of railway and canal was tried on the Grand Junction navigation at Grove, near Leighton Buzzard, and was patented (No. 13,851) by Mr. John Lake. A double row of wooden posts was erected in the bed of the canal, about 15 feet apart, and near one side, to leave the other free for traffic. Upon these posts were beams, having light iron rails screwed down upon them. The connecting rods of the engine worked cranks upon an axle carrying a pair of small wheels or rollers resting upon the rails. It should be stated that the surface of the rails was only about 18 inches above that of the water. In order to get sufficient bite, the driving shaft was pressed downward by a pair of levers attached to the boat, but their other ends could be raised by a screw to take the weight off if necessary. A double lock of 7½ feet rise in the experimental length of half a mile was fitted with an inclined plane, on which were rollers at regular intervals, in one-half of it. The other portion of the lock was kept in its original state for the ordinary conduct of the traffic. The rails gradually rose up the incline to the top, and then went down the other side till there was water enough to float the boats. At the bottom of the lock the gates, of course, were removed; at the top the floor of the incline rose a little above the water level of the upper pound, to prevent the water from flowing down. At the point where the first boat, owing to the rise of the bottom, would ground on the rollers, rack-rails began on the timbers and continued beyond the summit for about the length of an average train of barges. A tug fitted with a 10 horse power engine took four small boats, equal to about fifty tons dead weight, up this incline very satisfactorily into the upper pound. The vessels were old canal boats with their sharp ends cut off, so they fitted closely to each other. An experiment was then tried of working the boats back again down to the lower pound. This was accomplished simply by the engine being kept reversed while the boats, which must have been in front of it, began to run down by gravity. There were some very sharp curves on the trial length, but by making the rails a little wide to gage, not the least trouble was experienced from the fact. Mr. Lake estimated that a mile of line, probably single track, could be laid for £1,200 to £1,500, according to the kind of timber used, and an incline of average length for about £1,000. Considering the saving of water, lock-keeper's wages, and boat attendants, the system would appear sound on the face of it. With a 30 horse power engine it was estimated that 7d. or 8d. per mile would cover the cost of working a gross load of 300 tons. The specification plans show both single and double lines of rails, the central rows of posts being connected transversely for strength, and the two outer ones with the sides of the canal.

Even our old friend, the atmospheric system, was pressed into the service of canal traction, or at least it was hoped it would be, for in 1845, when the railway mania was at its height, there appeared the prospectus of Pilbrow's Atmospheric Railway and Canal Propulsion Company. The tube was to be buried, whereby leakage would be entirely avoided, and the application of the principle to canals would be "attended with incalculable advantages." We are not aware that it was ever tried for canal work. Twin-screw boats were apparently tested about 1849 on the Grand Canal in Ireland, built by Mr. John Inshaw, of Birmingham, who about that time numbered among his apprentices William Stroudley, well known afterward as the locomotive superintendent of the Brighton Railway. Screw boats were also used on the Lancaster Canal, between Preston and Kendal, about 1855. A 20 horse power engine, with two 8-inch cylinders, conveyed 200 tons of coal in five boats, but the water was so low that if more than two miles an hour was attempted, the bow wave caused the boat to scrape the bottom. The old idea of an iron twin-boat with one central paddle was also revived on the same canal, and was found to require less power. Experiments had been made with "the Archimedes screw principle" on this line, however, as early as 1840. Small screw engines were used in Regent's Canal boats in 1855, and so far as we know no new principle of mechanical traction has been used on British inland navigations since that period. The Thwaite-Cawley system of electric haulage, however, is to be tried, we hear, on the Leeds and Liverpool Canal, near Wigan.

Screw steamers, able to carry about 30 tons of cargo and to tow two or three large boats, have long been considerably used on the Leeds and Liverpool Canal, and between London and Birmingham, and no doubt elsewhere. The screw, whether driven by steam, electricity, or petrol, is so far the most efficient and convenient form of power for canal traffic, but mechanical traction, of course, only pays where there is enough trade to keep the steamers in regular work. If many of our canals have fallen into comparative disuse, it is not because better means of haulage than horse power were unknown or untried, for it is evident that a remarkable amount of inventive talent has been applied to the subject in past times, even since the railways began to supersede the old inland navigations.—The Engineer.

THE NEW SMOKELESS POWDER GUNS OF THE UNITED STATES NAVY.

IF one were asked to name the most important among the elements which go to make up the modern fighting ship, preference would have to be given to the armament; for it is certain that, whatever else a fighting ship may or may not have, she must carry guns, and plenty of them, if she is to be true to her name. The supremacy of the gun in modern warfare was suggested, if not proved, by the excellent results obtained with our extemporized warships in the way of converted merchant steamers, yachts, and tugs, which rendered such a good account of themselves in the Spanish war. Moreover, if our guns are to be fully effective against an enemy whose ability to maneuver his ships and handle his guns is supposedly equal to our own, there must be no deficiency on our side as far as the weapons themselves are concerned; they must be able to shoot as fast, as far, and as true.

The Bureau of Ordnance of the United States Navy is to be congratulated on the fact that it has always maintained the ordnance which is carried by our ships at the same high level, if not somewhat in advance, of the efficiency of the ships themselves. In the days of brown, smoke-producing powder, the guns of the United States Navy were fully equal to those in use abroad; and the weapons which have been designed and are now being manufactured at Washington to meet the requirements of the new smokeless powder, will be superior to those which are mounted in foreign navies; thus placing us for the first time in the lead in the matter of ordnance.

By the courtesy of Rear-Admiral O'Neil, we are enabled to present the two accompanying tables showing the ballistic qualities, both of our old guns built in the days of brown powder, and of the new guns of exceptionally long caliber which have been constructed specially to meet the requirements of smokeless powder. The guns given in Table I. represent the patterns built between 1883 and 1888, before the era of smokeless powder, when the brown powder was the only kind used in our navy. It will be seen that the length of the guns ranged from 30 calibers in the 10-inch to 40 calibers in the 4, 5 and 6-inch guns. Comparing these with guns of the same caliber in Table II., it will be seen that the smaller guns have been raised from 40 to 50 calibers in length, and the larger ones from 30 and 35 up to 40 and 45 calibers. The lengthening of the guns is due to the difference in the two powders, the brown being quicker burning (the charge taking less time to be converted into gas and therefore requiring less length of bore to develop its full accelerating energy upon the shell), the smokeless powder, on the other hand, being what is known as a slow-burning powder, and calling for greater length of bore in order to enable the combustion of the powder to be completed before the shell leaves the muzzle. It will be noticed that though the guns given in Table I. were built for the use of brown powder, the ballistic data are worked out for charges of smokeless powder, the intention being that in the future only this kind of powder shall be used in our navy.

A comparison of velocities and energies achieved respectively by the old and new patterns of the guns shows the improved ballistics resulting from the large powder chamber and great length of bore which characterize the new type. Thus the 50-caliber, 4-inch gun has a muzzle velocity of 3,000 foot-seconds as against 2,200 foot-seconds for the 40-caliber guns. The velocity of the 10-inch guns mounts from 2,200 foot-seconds to 2,800 foot-seconds, and that of the 12-inch from 2,300 to 2,800 foot-seconds, the increase in the muzzle-energy in each case being in proportion. It is interesting, moreover, to compare the 35-caliber 12-inch gun firing smokeless powder with the same gun when firing the old brown powder. In the former case the muzzle energy was 25,990 foot-tons; with smokeless powder this same gun shows a muzzle-energy of 31,170 foot-tons, while the new 40-caliber 12-inch gun with its larger powder chamber shows a muzzle-energy of 46,246 foot-tons, which, by the way, is 13,000 foot-tons greater than that of the 13-inch gun when firing brown powder, and 6,000 foot-tons greater than the same gun when firing smokeless powder.

The new guns are to be fitted with an improved type of breech-mechanism, invented originally by Welin, a Swedish engineer, and by him sold to the Vickers Company in England, from whom the United States has purchased the patent rights for this country for the sum of $200,000. In the new breech-block, by cutting the threads with varying radii, it has been possible to reduce the length of the block by 30 or 40 per cent. and thus save a great weight and bulk of metal in the body of the gun itself, besides securing a lighter breech-block, and one more easily and speedily manipulated. The mounting of the guns of the 6-inch caliber will be similar to that of the Vickers gun, with certain improvements incorporated by the Bureau.

In closing we would draw attention to an instructive comparison in the tables between the perforation through Harveyized armor and through the new Krupp armor, from which we learn, for instance, that while the new 12-inch gun can perforate 23·42 inches of Harvey armor at the muzzle, it is only capable of perforating at the muzzle 18·75 inches of the Krupp armor, the superiority of the Krupp armor being proportionately marked in the case of all other guns, whether it be at the muzzle or at the 1,000, 2,000 or 3,000 yard range. We commend this comparison to those Congressmen who are seeking to prevent the country from the purchase of Krupp armor at the reasonable price of $500 per ton demanded by our manufacturers.

TABLE I.—ELEMENTS OF NAVAL GUNS, GIVING PERFORATION OF FACE-HARDENED ARMOR AT RANGES UP TO 3,000 YARDS, WITH SMOKELESS POWDER AND UNCAPPED ARMOR-PIERCING PROJECTILES, AT NORMAL IMPACT.

Calibers of guns.	Length.	Weight.	Weight of projectile.	Muzzle velocity.	Muzzle energy.	Perforation at muzzle, Harveyed nickel-steel.	Perforation at muzzle, Krupp armor.	Remaining velocity at 1,000 yards.	Remaining velocity at 3,000 yards.	Perforation at 3,000 yards of Harveyed nickel-steel.	Perforation at 3,000 yards of Krupp armor.
	Calibers.	Tons.	Pounds.	Foot-secs.	Foot-tons.	Inches.	Inches.	Foot-secs.	Foot-secs.	Inches.	Inches.
4-inch..	40	1·5	33	2,200	1,107	4·05	3·24	1,817	1,245	1·88	1·50
5-inch..	40	3·1	50	2,650	2,434	5·90	4·72	2,175	1,466	2·68	2·14
6-inch..	40	6·0	100	2,550	4,507	7·88	6·30	2,212	1,665	4·46	3·65
8-inch..	35	13·1	250	2,300	9,168	10·44	8·35	2,079	1,698	6·97	5·58
10-inch..	30	25·7	500	2,200	16,775	13·46	10·77	2,033	1,736	9·81	7·85
12-inch..	35	45·2	850	2,300	31,170	18·02	14·42	2,151	1,882	13·79	11·03
13-inch..	35	60·5	1,100	2,300	40,338	20·28	16·22	2,164	1,917	15·91	12·73

NOTE.—With capped projectiles an increased thickness of from 15 to 20 per cent. may be perforated.

TABLE II.—TYPES OF NAVAL GUNS (MODELS OF 1899), GIVING PERFORATION OF FACE-HARDENED ARMOR AT RANGES UP TO 3,000 YARDS WITH SMOKELESS POWDER AND UNCAPPED ARMOR-PIERCING PROJECTILES, AT NORMAL IMPACT.

Calibers of guns.	Length.	Weight.	Weight of projectile.	Muzzle velocity.	Muzzle energy.	Perforation at muzzle, Harveyed nickel-steel.	Perforation at muzzle, Krupp armor.	Remaining velocity at 1,000 yards.	Remaining velocity at 3,000 yards.	Perforation at 3,000 yards of Harveyed nickel-steel.	Perforation at 3,000 yards of Krupp armor.
	Calibers.	Tons.	Pounds.	Foot-secs.	Foot-tons.	Inches.	Inches.	Foot-secs.	Foot-secs.	Inches.	Inches.
3-inch..	50	0·87	14	3,000	874	4·19	3·35	2,328	1,401	1·52	1·22
4-inch..	50	2·56	32	3,000	1,999	6·12	4·90	2,477	1,690	2·85	2·28
5-inch..	50	4·46	60	2,900	3,503	7·51	6·01	2,460	1,771	3·89	3·11
6-inch..	50	8·00	100	2,900	5,838	9·35	7·71	2,516	1,893	5·30	4·24
8-inch	45	18·00	250	2,800	13,602	13·57	10·06	2,531	2,068	9·06	6·61
10-inch..	40	33·40	500	2,800	27,204	18·57	14·86	2,587	2,209	13·53	10·82
12-inch..	40	52·00	850	2,800	46,246	23·42	18·74	2,619	2,291	17·92	14·34

NOTE.—With capped projectiles an increased thickness of from 15 to 20 per cent. may be perforated.

TRADE RISKS TO EYESIGHT.

FEW of us, perhaps, recognize the dangers to sight that are involved in some occupations. Mr. Simeon Snell, in his presidential address to the ophthalmological section at Portsmouth, said that in many trades associated with iron and steel small foreign bodies were very apt to be lodged in the workmen's corneæ. Even in the course of a single day a grinder might get several such bodies fixed in his cornea. If the cornea of a grinder were carefully examined with a magnifying glass, it would not infrequently be found to be studded over with minute nebulæ caused by the repeated slight injuries which had been thus received; and, if further testimony of the risks to which the grinder's eyes are exposed were required, it might be found by examining the spectacles of such grinders as use them. The surface would be found to be studded all over with marks caused by the impact of particles of steel or emery. Many workmen were, he said, very skillful in removing "motes," as these particles are called when they stick in the cornea, and the number which they removed in the course of a single day was

sometimes very large. One man, a timekeeper at works where 1,000 men besides outworkers were employed, stated that sometimes he had extracted a score or more a day, sometimes less, but that for many years he had not passed a day without having had at least one case. He, however, was not the only man at these works who had a reputation for removing "motes," and, probably, the total number of such accidents was very large indeed.—Hospital.

[Continued from Supplement, No. 1255, page 20115.]

THE HOMEMADE WINDMILLS OF NEBRASKA.

By Erwin Hinckley Barbour.*

THE HOLLAND MILL.

The Dutch or Holland mill is an old-fashioned form better known perhaps than any other mill, and needs no description. However, our farmers have modified them in such a variety of ways that their likeness to the mother mill is obscured.

Sometimes they are mounted upon tall, slender towers, or upon milk houses, sheds or barns. For the four fans, covered with duck, are often substituted six fans of thin lumber. The smallest of them are ten to twelve feet in diameter, the largest thirty-six feet.

A small Holland mill built by Wheeler & Bennett near Grand Island proved very interesting because of the use to which it was put. People living in the smaller cities and towns find it convenient to own their cows. Accordingly the town herd and herder, generally a boy on horseback, is a fixed institution. In the morning the cows are assembled and driven to pasture, and watered and cared for during the day, and returned at night.

By putting up this simple mill the owners of a neighboring pasture were able to accommodate a large town herd to advantage. Similar mills are to be found near Beatrice, Omaha, and elsewhere, but the best example is to be found on the farm of August Prinz near Chalco. It is a fine, stately structure, and a sort of landmark. Its cost, one hundred and fifty dollars, is large, but not out of proportion to the work performed, for it runs an eight horse power feed grinder, and turns out a grist of two hundred and even three hundred bushels of ground feed per day, in the ordinary winds of winter, when it is in use grinding feed for stock. We had no means at hand for measuring its true efficiency, and assume that its working efficiency is at least eight horse power, as measured by the grinder which it runs. Furthermore, it grinds away without superintendence, for it elevates the grain, and discharges the grist into the proper bins automatically. In a good wind four

Fig. 22.—The stationary six-fan Turbine mill designed and built by Frederick Mathiesen, near Grand Island, giving front and side views. Made of parts from an old mower; 12-foot tower; 9-foot wheel. Waters fifty head of cattle. Cost between $4 and $5.

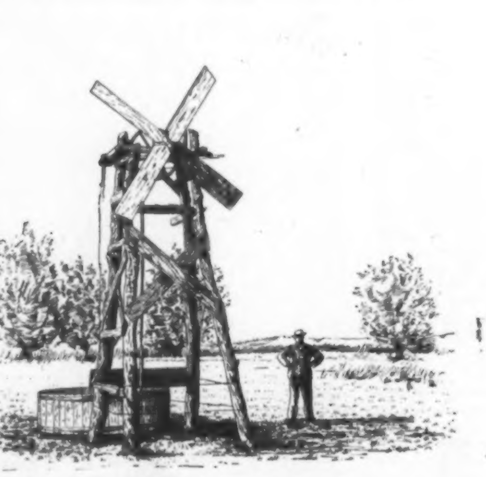


Fig. 23.—The four-fan Turbine windmill of Mr. Friederich Ernstmeyer, near Grand Island, Nebraska. Built on the framework of an old mower, the frame of which was bolted directly to the cottonwood tower. A brake (worked by the wire to the left) rubbed against the cultivator wheel seen just back of the fans, so as to check or stop the mill. Diameter of wheel, 8 feet. Cost 32 cents (for a 16-foot board for the fans). Pumps the water for the stock of the place.

sails give too much strength, so two are generally furled. The mill is so well built that its term of usefulness must continue for ten to fifteen years to come.

Many cannot afford so expensive a mill, nor is it necessary; but in cases where big work is to done, then big machinery must of necessity be employed.

THE TOWERLESS TURBINE.

The simplest Turbine found thus far is one south of the Platte some twenty miles from Gothenburg, in Dawson County. This paradox of a mill consisted simply of the wheel, without tower, axle, crank, cog, or sprocket wheel, or other working parts, yet it worked and cost nothing, and defies competition along the line of simplicity. The farmer simply bolted an old wagon

Fig. 21.—The large Dutch mill built by Mr. August Prinz, Chalco, Nebraska. Diameter of wheel, 36 feet; capacity, 200 to 300 bushels of ground feed a day, according to the wind; efficiency between six and eight horse power. Runs an eight horse power feed grinder. Cost, $150. The designer prepared his own models, and had them cast in Omaha.

axle to a beam on the south side of the barn, put some axle grease upon the spindle, put on the wheel as of old, to which he had previously nailed slats or blades, screwed on the nut, attached the pump rod, and had the satisfaction of seeing it go, and at last accounts it was still running. The crank was simply a heavy spike driven into one edge of the wooden hub.

It was begun and done in a few hours, cost nothing, and pumps water. Where is its equal for simplicity? Of course it is a low grade mill, and runs only when the wind is from the south—its prevailing direction—

Fig. 24.—Front view of the six-fan set Turbine windmill of Fred. Mathieсen, near Grand Island, Nebraska. Diameter, 8 feet.

Fig. 25.—Stationary Turbine windmill of the Janak Brothers, Sarpy Mills, Nebraska. The wheel, 10 feet in diameter, made of weather-boarding, stands facing the south, and accordingly is efficient in north and south winds only. This mill pumps water for thirty head of cattle, has been in service three years, and cost $3 to $4, including the tower.

and yet one must not demand too much of that which cost neither time nor money.

From this point one goes up the scale rapidly, and the mock Turbines begin to have towers; then they are made to revolve upon their towers, so as to face any wind; then they begin to have rudders to guide themselves automatically, and so on to the last degree of refinement.

STATIONARY TURBINES.

As the next simplest mill of this type we may select out of a long list that of Fred. Mathiesen, near Grand Island. It is full of suggestions, though rough and cheap. Some locust poles cut from the place were well anchored and roughly braced. Upon this tower was bolted the driving parts of an old self-binder, with journals, bearings, and crank in place. To the crank of the sickle driver was attached a slender pole which was bolted to the pump rod, and to the other end of the shaft was attached six rough board fans, and the mill was done, and cost but a dollar or two at most, and pumped water for the stock in a large pasture

The brake was the embodiment of simplicity. To stop the mill a rail was pushed forward between the fans, and nothing more need be said about this simple brake. To start the mill, the obstruction was removed. These are mills of great number and variety, and only occasionally one admits of mention, the ground plan of all being essentially the same.

They are made in a set or fixed position upon the tower, and are consequently inefficient in winds from the east or west, but work well in those from the north and south.

A short distance beyond we found the set Turbine of Friederich Ernstmeyer, a simple four-fan mock Turbine, which interested us because the mill was well built and neatly mounted upon a cottonwood tower, the whole structure being attractive, if not even artistic, and yet the cost was but thirty-two cents (the price of a sixteen-foot board out of which the fans were built). This, like the foregoing, used the frames and working parts of an old reaper, so it ran upon fairly frictionless bearings, and responded to light winds, and pumped the water needed for his stock.

The brake was rather simple and ingenious. It consisted of a cultivator wheel wedged securely to the axis; against this rubbed a beam guided by a lever at the ground. It was a small matter to either check the speed of the mill or to stop it outright.

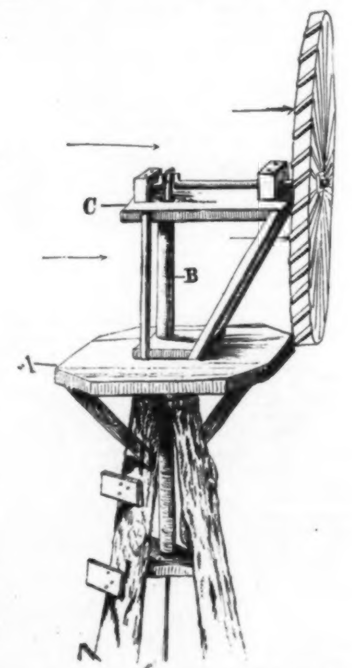


Fig. 26.—A plan for the construction of simple vaneless Turbines, as proposed by the writer. Tower of poles. *A*, platform; *B*, stationary axis of 3-inch gas pipe around which turns the platform, *C*, which supports the mill. The arrows show the direction of the wind.

These may be taken as fit representatives of the four-fan, six-fan, and eight-fan Turbines, and we come to those having many fans. They are still stationary or fixed Turbines; that is, set for north and south winds only; aside from this they resemble the ordinary mills. A good example is found in the mill built by the Janak Brothers at Sarpy Mills, near Omaha.

The older brother, who had arrived from Bohemia

* Condensed from the Bulletin No. 59 of the United States Agricultural Experiment Station of Nebraska, Lincoln, Neb., to which we are indebted for kindly lending the engravings.

about three years before, found a neighbor in need of a mill for pumping stock water for about thirty head of cattle. Accordingly, at a cost of three or four dollars, he put up the ten-foot set Turbine shown in Fig. 25, and it has been in operation ever since. Its working parts are very simple and are perfectly obvious from the sketch. The wheel was painted red and white, which gave it a finished look.

VANELESS TURBINES.

In making the homemade windmills, a good many lose sight of the fact that their mills may be built in such a way that they will naturally swing around and stand in the wind with the intervention of a rudder, and this brings us to the vaneless Turbines.

Almost any steel mill, in case of the loss of its rudder, will yet swing around with its back to the wind instead of its face, and yet continue to run about as well as before, though backward. This fact is taken advantage of, and thus one mechanical part is easily dispensed with, and greater simplicity secured, which is the highest attainment in the art of inventing.

The vaneless mill of W. F. Baldwin, of Ainsworth, Brown County, when visited in the fall, made a fine showing, as good as could be expected of any first model. Eight similar models built for neighbors were giving entire satisfaction and were better built. If this same mill were built at the shop, and with the same care which is bestowed on the steel mill, it would scarcely find a superior. Its arrangement for adjusting itself instantly to every varying wind, whether a gust or zephyr, seemed very sensitive and hardly to be improved upon.

The idea which led to the invention is this: In the ordinary steel mill the fan is struck by the full force of a sudden gust before its mechanism begins to turn it out of the wind and so to adjust it. In the meantime it sustains the shock of the full wind. This led Mr. Baldwin to devise a method whereby the regulating lever should be struck by the blast first, and so throw the fans as to escape the full fury of the wind. He has attained this end in a very clever way by means of a regulator or rudder-like lever in front of the fans. The slightest motion of the lever is instantly conveyed to the fans, which are turned edgewise more or less, according to the velocity of the wind, thus adjusting it with nicety. A little further examination will show a weight suspended to this lever, which tends to keep the blades always in action. When the weight is removed, the fans are exactly edge to the wind, so the mill is completely out of gear. Detailed drawings and the working parts will be shown at another time, and photographs of the mill and surroundings will be furnished as soon as space and means will allow.

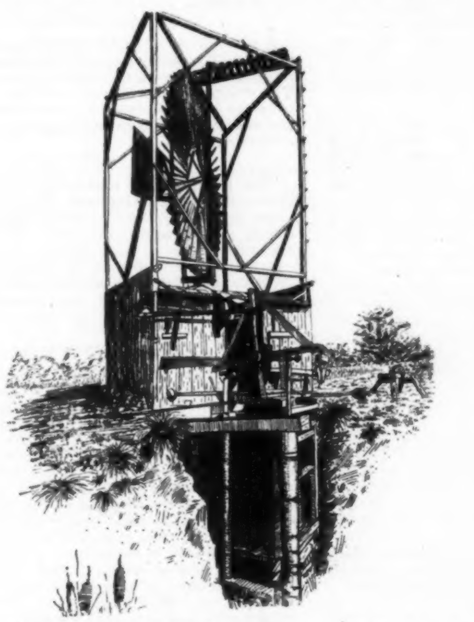


FIG. 27.—Giant Turbine windmill designed and built by Mr. J. W. Warner, near Overton, Nebraska. Diameter, 20 feet; runs a four horse power feed grinder and other machinery, and drives two pumps, one with a 5-inch, the other with a 4-inch cylinder; 14-inch stroke; 8-foot lift. Irrigates ten acres of alfalfa and six to eight acres of corn. Cost, $60.

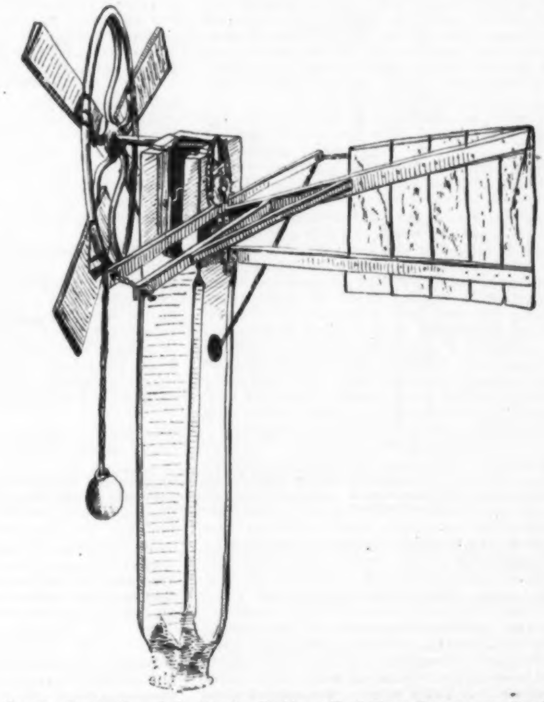


FIG. 29.—Construction of the four-fan Turbine mill of Henry Boerson, near Grand Island. The head of an old wooden pump serves as the axis on which the mill revolves The driving parts consist of the fly-wheel and sprocket-wheels of an old corn sheller. The fans were wired to the spokes of the fly-wheel. Geared in the ratio of three revolutions of the fans to two strokes of the pump. A crossbar nailed to the pump head carries two pulleys (made of spools); a weighted piece of rope, passing through one pulley and attached to an arm on the rudder, tends to hold the rudder in position. A pull on the opposite rope, which passes down the center of the wooden pump head, throws the rudder to one side and the mill out of gear. Eight-foot wheel; pumps water for sixty head of cattle. Cost, $2.

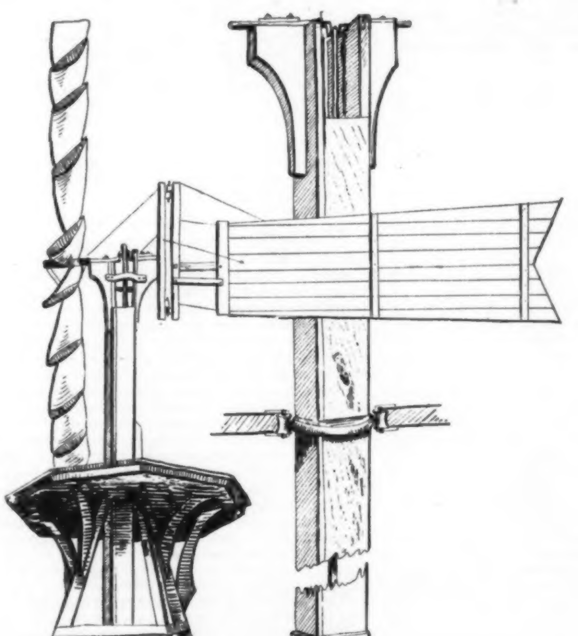


FIG. 28.—Showing the construction of the homemade Turbine mill built by Mr. W. F. McComb, Grand Island, Nebraska. This is often mistaken for a regular shopmade mill. Diameter, 10 feet. Cost about $20.

FIG. 30.—A reconstructed windmill seen near Kearney, Nebraska. Thin lumber was nailed at the proper angle upon the somewhat lengthened and strengthened arms of an abandoned windmill.

It has been used pumping water for the house and stock for three years past, and is good for several years of service yet, and the whole mill cost but five dollars, which shows what a small water tax the man with the windmill has to pay, as compared with many a man in the city.

GIANT TURBINES.

In regions subject to high winds there is a risk of mills on high towers being overthrown, especially when the diameter of the wheel is increased above ten or twelve feet; so in order to get breadth of base and corresponding stability, we find a mill which is built inside of its tower instead of upon it. This is the remarkable giant Turbine of J. W. Warner, four and one-half miles southeast of Overton.

This giant Turbine, with its twenty-foot wheel, is the largest known as yet, and while its true efficiency could not at the time be measured, yet it runs a four horse power feed grinder, which is a practical measure of its strength. However, it runs the grinder with less speed than the four horses. It is probably a two or three horse power mill. It also runs the grindstone and other machinery by means of overhead shafting with pulleys and belts. It is also connected to a walking beam and drives two large pumps with a thirteen-inch stroke, one pump having a four-inch and the other a five-inch cylinder. The owner says they should have been six-inch cylinders.

As it stands, it has irrigated eight to ten acres of alfalfa and six or eight acres of corn by pumping directly into the furrows. Mr. Warner believes that when a proper storage reservoir shall have been built, he can irrigate twenty acres sufficiently for that region, where good yields are assured without irrigation.

The expenses of this mill—an especially well-built and painted one—amount to nearly one hundred dollars. But now that the owner's original ideas are put into material form, he could build the same mill in less time and at half the cost.

It is a splendid-looking structure and has no equal in its class, although two other similar mills, built upon a somewhat similar but smaller plan, are known farther west, near Lexington. (See Fig. 27.)

MOCK TURBINES.

Our mock Turbines so closely resemble the shop-

made mills that they pass for them, and this is why they are so seldom noticed.

As an example, we will select the mill of W. F. McComb, of Grand Island. The fans are of metal, the rudder of light wood, easily thrown in and out of gear. It lifts water forty-four feet and irrigates garden and lawn, and costs a possible twenty dollars, and has been in service since the spring of 1897.

Some of our mock Turbines are made with less care and some with greater, but all are quite like the shop-made article.

If anyone contemplates building so elaborate a mill, one which must consume time and money, and which comes dangerously close to the price of a regular one, he is advised to consider the practicability of patronizing his nearest windmill agent, or else to buy and repair some damaged mill.

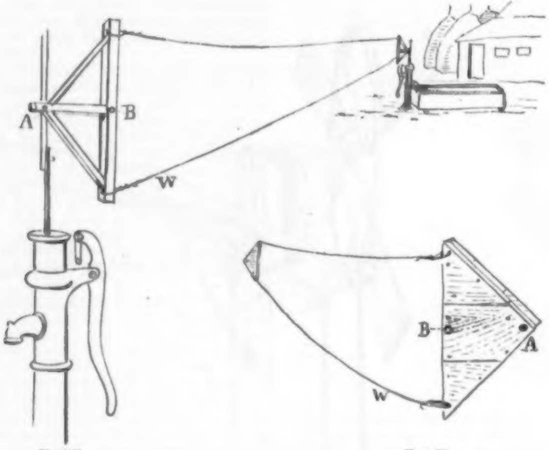


Fig. 31. Fig. 32.

Fig. 31.—To show how windmill energy may be transmitted from one point to another by means of homemade quadrants and oscillating wires. Fig. 32.—A still simpler form, made of boards nailed together cross grained. *A*, attachment to pump rod; *B*, attachment to tower or stationary support; *W*, strong fencing wire.

THE RECONSTRUCTION OF WINDMILLS.

These mills rank in importance next to the regular mill, and offer possibilities which many may avail themselves of to good advantage. There is scarcely a community without several damaged and fallen mills, sometimes new or but little worn. Sometimes good mills and towers are overturned by a heavy wind storm—we have found as many as fifty in the path of a single storm—and there they lie to be grown over with weeds. At the busy season, when such storms are most frequent, man cannot afford to abandon the larger and more important work of tending the growing crops to put up a mill. For the man of moderate means it is often better policy to send for the windmill agent and order a new mill put up. But for the man of less means, the fallen mill opens opportunities. He can now buy the fallen mill of his neighbor at his own price. The essential parts will be damaged but slightly and the other parts may be easily restored.

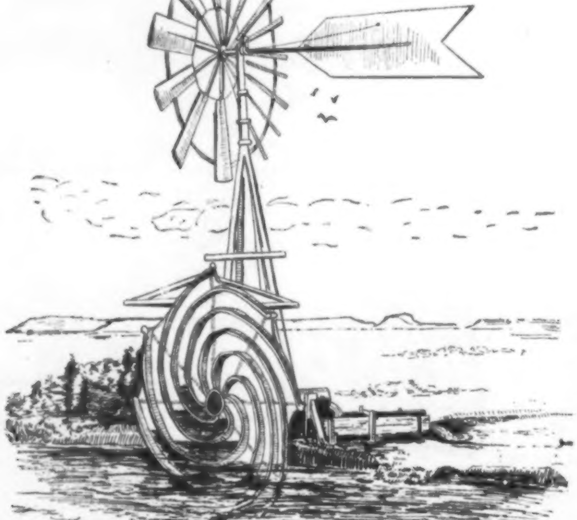


Fig. 33.—A 12-foot Aeromotor windmill attached to a 12-foot water wheel of the tympanum variety, designed and built by Mr. Thomas, North Platte, Nebraska.

Judiciously managed, the cost of such reconstruction will not exceed that of a Jumbo or Battle-ax, and with better results.

Then again there is the mill which stands in disuse because of some accident to the fans, rudder, or other essential and easily restored parts. Such mills may be purchased at small cost, and after a little repair may be reinstated upon their towers, not quite as good as new, but almost as serviceable.

Another mill, rather an elaborate affair, stood upon its substantial tower, which formerly had supported a fine shopmade mill. After this mill had become a skeleton, with little left but bare arms, it was restored to life and usefulness by nailing on a few paddle-shaped boards for fans. The original mill was used for watering a large garden and lawn and for starting trees about the place. The rejuvenated mill was doing almost as much and cost nothing.

At Kearney, we found a reconstructed mill and a storage reservoir filled with water as in its better days. The arms had been lengthened a trifle, and at the extremities of each three thin boards from the sides of boxes had been nailed. It was a crude affair, but that matters little when we know that it did its work well.

The matter of reconstructing and reclaiming abandoned, damaged, and fallen mills offers many possibilities, and the writer would call the especial attention of farmers and others to the advantages which may be secured in this way.

TRANSMISSION OF WINDMILL ENERGY.

Sometimes our farmers find the well so situated that the windmill and tower cannot be set up without interfering with the porch, kitchen, and milkhouse; in which event, a walking beam or rocker shaft often connects the mill and pump. If too distant, recourse is had to the angle block and connecting wires. In this way the mill at the house can be geared to run the pump at the barn, or even in a neighboring field.

The better way is to purchase such things of the man whose business it is to make them, and so have undivided time for one's own business. But when one wishes to make his own angles it is a simple matter, and several sketches are appended to suggest what may be done in transmitting the energy of the mill by means of two oscillating wires and a couple of quadrants cut out of a board.

A French naturalist quoted by Popular Science News asserts that "If the world should become birdless, man would not inhabit it after nine years' time, in spite of all the sprays and poisons that could be manufactured for the destruction of insects. The bugs and slugs would simply eat up all the orchards and crops in that time."

COMPETITION FOR THE BEST LIFE-SAVING DEVICE IN CASES OF DISASTER AT SEA.*

ANTHONY POLLOK MEMORIAL PRIZE.

REGULATIONS.

THE Commissioner-General of the Universal International Exposition of 1900,

Considering the letter of the Commissioner-General of the United States, dated May 9, 1899;

Considering the dispatch of the United States Ambassador to France to the Minister of Foreign Affairs of the Republic of France, dated May 27, 1899, and the reply of the Minister of Foreign Affairs, dated June 15, 1899;

Considering the dispatch of the Minister of Foreign Affairs to the Minister of Commerce, Industry, Post Office and Telegraph, dated September 14, 1899,

Decrees:

ARTICLE I.

A competition will be opened at the Universal International Exposition of 1900 for the best life-saving apparatus or device for use in cases of disaster at sea. The competition will also include devices designed to save life by preventing a vessel from sinking at sea as the result of collision with another vessel, an iceberg, or other object.

ARTICLE II.

The competitors must be exhibitors in Class 33 (Equipment for Merchant Marine) under the conditions defined by the General Regulations of the Exposition. This admission does not exempt them from presenting special applications for participation in this competition, which must be addressed, before March 1, 1900, to the Commissioner General of the Exposition, either directly if they are French, or through the Commissioners-General of their countries if they are foreigners.

ARTICLE III.

The devices or inventions themselves may be exhibited. Working models or drawings to a reduced scale will also be accepted. In all cases, the competitors are required to explain their applications by written statements containing the following information:

Detailed description; construction, stating method of manufacture or fabrication in detail; nomenclature of each separate part, stated in list form, with reference letters corresponding to letters on accompanying drawings; kinds and quantities of materials used in construction; dimensions of all parts; weights of principal parts and total weight of apparatus or device; estimated cost at which it may be furnished; description of method of using; claims of inventor for device set forth specifically, in full, and in numerical order; whether device or any of its parts is covered by letters patent or caveat in any country? If patented, in what country or countries, giving registered number or numbers of patent or patents? Whether it has ever been actually used or tried? If so, when, where, and with what results?

ARTICLE IV.

A prize of one hundred thousand francs (100,000 francs), under the name of the Anthony Pollok prize, is offered by the heirs of the late Mr. Anthony Pollok, of Washington, to perpetuate the memory of their relative, who perished with Mrs. Anthony Pollok in the wreck of the ship La Bourgogne, in collision with the Cromartyshire off Sable Island, July 4, 1898.

The amount of this prize is deposited with the American Security and Trust Company of Washington.

ARTICLE V.

The competition will be judged by an international jury, according to the rules set forth in the General Regulations of the Exposition.

ARTICLE VI.

The jury will have the right to require trials and tests, for which, in agreement with the Commissioner-General, it will afford all facilities possible. All expenses, connected with the trial and testing of the apparatus or device, shall be borne by the competitors.

In passing upon the merits of the devices or inventions, the jury will take into consideration not only their values as preservers of life when once in the water, but in case of appliances which depend upon the aid of persons other than those to be rescued (such as boats, rafts, etc., as distinguished from life-preservers and the like), it will take into account the facility and safety with which they may be detached or launched from the vessel under any conditions. The weight of the device or apparatus, its facility for carriage upon the vessel, the space occupied, its capacity and adaptability for carrying numbers of persons, the means of sustaining life when in the water, its seaworthiness, its durability, and its cost of maintenance in the service, will all be considered.

ARTICLE VII.

The jury shall have power to dispose of the prize in the following manner:

First.—It may award the entire amount of 100,000 francs to one person submitting the best original apparatus or device for the saving of life in case of disaster at sea, provided it is, in the opinion of the jury, of sufficient value to the world to justify the award;

Second.—In case two or more persons shall submit devices which shall seem to the jury to be of equal or nearly equal value, there may be awarded to the several inventors thereof such a ratable proportion of the entire sum as the jury may deem just; or

Third.—In case none of the devices presented shall be deemed by the jury of sufficient value to justify the giving therefor of the prize offered, the jury may reject all, but may reimburse any competing inventor for his expenses, wholly or in such part as it may judge proper.

ARTICLE VIII.

The decision of the jury will be made known to the Secretary of State of the United States, by the Commissioner-General of that country to the Exposition. The Secretary of State of the United States, through the Commissioner-General of that country, will attend to the payment of the sums awarded by the jury.

ARTICLE IX.

The device or inventions awarded prizes shall be

* Published in full at the request of many readers.

known as Life-saving apparatus—Anthony Pollok prize.

ARTICLE X.

The present regulations will be distributed to competitors through the French Commissioner-General of the Exposition, and through the foreign Commissioners-General, each for his own countrymen.

Done at Paris, December 15, 1899.
The Commissioner-General
of the Universal Exposition of 1900,
ALFRED PICARD.

Read and accepted:
Paris, December 15, 1899.
The Commissioner-General of the United States.
FERDINAND W. PECK.

Detailed plans and specifications of apparatus for Pollok Prize competition should be sent to

JOHN H. MCGIBBONS,
Director of Exploitation, Paris Exposition Commission,
Equitable Building, 120 Broadway, New York,

and should be marked

"POLLOK MEMORIAL PRIZE."

Small models may also be sent there.

If a decision as to merits of apparatus cannot be reached by the Committee, the competitors will be asked to send such additional matter as may be necessary, including larger models, and, in certain cases, apparatus itself. WILLIAM KER, Secretary.

INFLUENCE OF VARIOUS OXIDES ON INCANDESCENT MANTLES.*

By W. BRUNO.

No one is now ignorant of the importance which incandescent mantles have attained in lighting technics. It has been recognized that with the aid of an incandescent substance a considerably greater quantity of light is obtained than through the ordinary open flame, and efforts are now being directed toward adapting all the fuels heretofore employed for illuminating purposes, for the use of incandescent mantles. Among these are, naturally, to be ranked all those fuels which heretofore, on account of their low percentage in carbon, were not adapted for illuminating purposes, to which, however, by the aid of the incandescent mantle, the possibility is given of transforming into light the heat of combustion. Hand in hand with these efforts have gone the experiments for the improvement of the incandescent body itself. There are still two conspicuous defects inherent in the incandescent mantle of the Welsbach light. The first is the falling off of light after a longer or shorter time, and the other is the great delicateness of the incandescent mantle.

It is known that the Welsbach mantle consists of the oxides of thorium and cerium, and that it is a structure of extraordinary fragility. This latter property follows from the absolute necessity that the mantle be extremely fine and light so as to offer no great resistance to the flame.

In the contrary case, there would be too much heat absorbed by the mantle, which would not be transformed into light. In this connection I must remark that all attempts, whether individual or united, to construct a so-called "firm" incandescent mantle have failed on account of these difficulties. The firmer substance or the greater mass of substance absorbs a disproportionately greater quantity of heat, which is thus not transformed into light.

Of the innumerable attempts that have been put forth in this direction, not a single one has yet matured to a state of more than partial utility.†

The firmness of the mantle can be increased, to a certain degree, by using a very strong solution of the thorium and cerium salt for impregnation; the increased firmness aimed at is, however, so small that it is practically of no value. The power of light emission possessed by such mantles is also considerably less than that of the incandescent mantles usually manufactured.

The attempt has been made to manufacture incandescent bodies from fine wires or from incombustible threads. The idea of obtaining through this means a firm incombustible incandescent mantle lies very near to the correct solution. The result has been always an entirely negative one, and it was necessarily so from the reasons previously stated. After it was perceived that in this way a firmness or at least a notable hardness and capacity for resistance of the mantle could not, without further treatment, be combined successfully, the attempt was made to arrive at the desired result in another way. A simple means of securing an increased firmness is through the elevation in temperature of the same flame with which the mantle was annealed and hardened in manufacture.

In the larger factories for the manufacture of incandescent mantles the employment of compressed gas for the formation and hardening of the mantle by aid of air pumps is common. With this contrivance it is a very easy matter to elevate the pressure of the gas to any desired height. The velocity of the gas at the discharge orifice increases with the pressure, and with this the capacity of drawing the air along with it, uniting with the issuing stream of gas, and by this means increasing the temperature of the blue flame which is formed. But even here certain limitations exist. With a pressure of more than 79 inches, or at most 118 inches water pressure, the mantle becomes exposed to the danger of being torn into pieces or carried away through the vehemence of the issuing gas.

The use of oxygen is impracticable from an economic standpoint, likewise also that of water-gas, since this gas requires for its production apparatus whose cost of installation is considerable. In both cases the cost of production of mantles would be increased unduly. Regarding the serviceableness of mantles annealed especially hard, it may be remarked that hard mantles surpass the soft ones in firmness only in a slight degree, so that there is no practical superiority secured. On the other hand, it is to be remarked that hard mantles, though corresponding in a substantially exact manner to the soft ones, are in respect to their power of light emission inferior to the soft. These reactions are incapable of being demonstrated by single photometric measurements, for which an entire series of observations is required, and the results can be condensed into a judgment only in course of time through continued experiments. This disadvantageous property of hard mantles is due to the fact that the oxides are more firmly smelted together by the high temperature.

The use of sulphates in place of nitrates seems to confirm this view, since the mantles whose impregnating liquid contained partly sulphate became somewhat firmer and harder; yet, on the other hand, did not show the high luminous effect of the mantles produced from pure nitrates. The thorium sulphates in the crucible show a far less porosity than the thorium nitrates; of equal significance with the elevation of temperature is a longer duration of the mantle in the ordinary blue flame.

It can be observed that every mantle which has been in the burner for some hours becomes considerably harder. It is, however, likewise a well known fact that each of the incandescent bodies now known, in the course of its first 100 hours of burning, i. e., in the time of its hardening, loses in light the most rapidly, and that when the hardness no longer increases, the diminution of its illuminating power takes place less rapidly.

I have always found that the softer mantles turned out the more favorably photometrically, and that the hard mantles are duller in luminous effect, yet fall off less rapidly in illuminating power. An equilibrium between the two took place usually after about 200 hours of burning. From then onward both series continued photometrically alike. These phenomena were previously observed with all mantles, no matter of what manufacture. It may also be stated that the illuminating power of a mantle is inversely proportional to its hardness.

Later in the discussion I shall return to this sentence, which has been the foundation of a series of interesting experiments.

Besides by the means stated, hardness of the mantle may also be produced by definite additions of thorium and cerium. In the following I review the principal experiments; all solutions are in the ratio of 4:10, and the addition of the 0·1 upward was made. The solutions were of nitrates throughout.

Aluminium.—With 1 per cent. a certain elasticity and toughness of the mantle is already observable, which increases with the content of aluminium and finally leads to a firm body with a great capacity for resistance. The light remains equal to that of the pure thorium-cerium mantle, as well in respect to intensity as also to its color. With all mantles containing aluminium appears the distinct tendency to contract inwardly just above the top edge of the burner. This phenomenon occurs also in the absence of traces of aluminium and was not entirely to be obviated. Self-evidently, the candle power of the mantle lowers with this deformation, so that with a considerable content of aluminium, after about one hour not more than half the original illuminating power is obtained.

Magnesium.—This is closely related to aluminium in its properties, producing with additions of about 1 per cent., cracked mantles. Below 1 per cent. it remains in this respect less dangerous, causes a certain brittleness which in lighting, in consequence of the explosion which is very often unavoidable in gas chimneys, bursts the mantle. The firmness is otherwise similar to that of the mantles containing aluminium. The light is unchanged. The experiments with aluminium and magnesium offered for them at first a field rich in prospect, on which account, even from the other side, greater attention has been turned. The magnesium seems to be adapted to replace thorium. The pure magnesium mantle is similar to the thorium mantle, of a pale bluish color and also without light emission. If, now, cerium be added to such pure magnesium mantles, there appear the gradual shades from bright yellow to deep golden yellow, according to the content of cerium, just as in the thorium-cerium mantles. It has been an impossibility, at least for me, to prevent the appearance of cracks and to form the mantle symmetrically in the flame of compressed gas. With the least manipulation of the flame there occurred peculiar deformations, so that a mantle was seldom in any degree valuable. All attempts by mechanical or chemical remedies to correct this evil completely failed. The application of nitrate of ammonia, which is successfully used by the Auer companies in order to prevent the stretching of the mantle caused by the shrinking inward, did not contribute toward any improvement.

Beryllium is similar to both these materials in very low specific weight. The same gives, with additions of up to 0·5 per cent., mantles which can not be distinguished from the pure thorium-cerium mantles, and they remain soft and sensitive. With a higher content of beryllium, the mantles shrink both in length as well as diameter, so that they become too narrow for the ordinary burner. This action continues incessantly during the first hours of the burning. The mantles become hard and firm, but, on account of the property named, are useless. Through the employment of a larger tissue nothing is attained, since the shrinkage only comes to a standstill when the incandescent body has reached the inner zone of flame. This was accompanied by a series of experiments with zinc, with which a diminution of the illuminating power was remarked, so that the same was soon given up as worthless.

Cadmium.—The mantles containing cadmium behave similarly to those composed of magnesium; there also occurs during the first hour of burning a tendency toward the conical shaping of the mantle. An increase in firmness or any indication of hardness is scarcely perceptible. Cadmium in no way affects the illuminating power.

Calcium.—All mantles composed of calcium shrink strongly in length and also in diameter, and contract inwardly over the flame of a compressed gas. The illuminating power is weakened according to the proportion of lime contained. The phenomena are similar to those of a mantle whose tissue is impure or leaves behind it a strong residue of ashes.

Potassium and sodium have a like effect upon the mantle—they cause a somewhat conical formation; the top of the incandescent body draws itself out toward the point of the flame. Both are adapted to give the mantle a light yellowish tint, which in contrast with the yellowish tint produced by cerium does not disappear with a long continued burning. In light, these mantles hold out better than the pure thorium-cerium ones. A too high content of sodium is indicated by the fact that the mantles when reduced to ashes turn gray and also fall away easily. For the perfection of the mantle a series of experiments was instituted, with which two or more of the substances named were combined and added to the thorium-cerium solution, in addition also to various combinations with acids. Through these combinations no other results than with the individual substances are attainable, since the specific properties of one of the combined bodies usually predominate and the combination does not take on new properties. A very useful mantle which also, in respect to its hardness and compactness, furnishes satisfactory results may be formed by the addition of about 1·5 per cent. of one part magnesium and two parts thallium. The mantles are somewhat difficult of shaping in the flame of compressed gas, yet through treatment with selenic acid a substantial improvement is secured.

Selenic Acid.—Mantles containing selenic acid show peculiar phenomena. In the cold state they give occasionally in the dark a weak phosphorescent appearance. Mantles are in general dielectrics. If a selenium mantle be put into water through which an electric current of only moderate intensity is made to pass, the mantle instantly shows a slight luster. If this experiment be repeated with a greater number of mantles so arranged as to be in contact, and the water then be allowed to run off, a sensitive galvanometer will be agitated as soon as it is connected by a copper wire with both ends of the series of mantles. If nitric acid be introduced into the water, the phenomena become more marked. Pith balls are repelled by the mantles. The discharge of an electric battery above it does not give rise to any phosphorescent appearance.

Yttrium.—A very interesting experiment is that with yttrium. According to the analysis of the Auer fluid, yttrium is contained therein in minutely small traces. Additions even of traces of yttrium gave the incandescent body a very peculiar appearance, the light becoming brilliant. An yttrium mantle, even for those who know the luster of yttrium incandescent bodies, is unrecognizable when placed in a long series of mantles. The brightness of this mantle increases with its content of yttrium. Moreover, these bodies are exceedingly hard, without, however, being brittle. Unfortunately, the first named beauties are very perishable. With more than traces of yttrium, say with the presence of 0·5 per cent., the light of the mantle diminishes greatly, so that after 24 hours of burning only a pale dull light remains as the miserable remnant of its former splendor and brilliancy. I believe that I am, however, able to say that for increasing the brilliancy of the mantles a very minute addition of yttrium appears efficacious.

Didymium bears a similar relation to incandescent bodies as yttrium. It is well known that this metal is found combined with cerium, and the aim of chemical factories occupied with the preparation of cerium is directed toward the production of cerium as free as possible from didymium. Didymium causes a still more energetic depression of light than yttrium. The presence of didymium in the cerium nitrate is indicated by the spectroscope, the didymium line being plainly visible in the spectrum.

Lanthanum belongs among those substances which produce a certain hardening of the mantle, causing at the same time a depression in the illuminating power. If lanthanum be added otherwise than in minute quantities, it gives a brownish light.

I pass over that series of substances which through their peculiar coloring of the light are, therefore, not adapted for securing an increased firmness in the incandescent substance, such as chromium, cobalt, zirconium, uranium, etc.

Prof. Hintz, of Wiesbaden, has observed that zirconium added in small quantities produces an increase in the luminous power. (See "Ueber Gasglühlicht," by Dr. Ernst Hintz, Wiesbaden; C. W. Kreidel, publisher; 1898.) None of the substances last mentioned are adapted as a substitute for thorium, since they give no coherent structure. The mantles fall into a powder when reduced to ashes. Only the three first named, aluminium, magnesium and beryllium, show any coherence. Beryllium, on account of its high price, can not be taken into consideration as a manufacturing material.

* Translated by Progressive Age from Zeitschrift für Beleuchtungswesen (July 10).

† These deductions are in perfect congruity with our own which we made in the year 1895, and published in vol. I., page 73.—Ed. Zeit. f. Beleucht.

IODINE IN ARTICLES OF DIET.

IODINE has not hitherto been presumed to be present in any important quantity in alimentary materials, but according to recent researches, which have opened up a very delicate process for the detection and estimation of iodine, this element occurs certainly in the flesh of fish and shell fish in not a negligible quantity. It is true that traces of iodine have been found in cod liver oil, which with other elements such as bromine and phosphorus probably exert a slight specific action and possibly a favorable influence on the absorption of the oil, thus contributing in some measure to its tonic effects. The flesh of fish is peculiarly nutritive though less satisfying and perhaps less stimulating than ordinary kinds of meat. It is able to be digested more easily and rapidly than is animal flesh, and on these considerations affords a useful food for invalids. But most fishes contain iodine, and thus the occurrence of this element may be a factor of importance in the suitability of a fish diet for invalids. The herring appears to be at the top of the list, containing two milligrammes of iodine per kilogramme. Next come mussels, 1·9 milligrammes per kilogramme; next salmon, 1·4 milligrammes per kilogramme; then ling and cod, 1·2 milligrammes per kilogramme, and the same amount in oysters. The salmon trout appears to contain the smallest quantity, which is only 0·1 milligramme per kilogramme. These results are interesting, and doubtless the inquiry will be extended to other articles of diet, though on the face of it there is more probability of iodine occurring in fish than in mammals or vegetables.—The Lancet.

THE PAN-AMERICAN EXPOSITION OF 1901.

By Roy Crandall.

Even the leading optimists of the Pan-American Exposition, which will be held at Buffalo in the year 1901, did not dare to hope at the outset that the countries of South and Central America would warm to the project and with great cordiality volunteer representation at this early stage. They expected, and rightly too, that the government of the United States, the Empire State, and a very fair percentage of the States of the Union would make appropriations; they hoped that the Dominion of Canada would cross the border and enter into friendly trade rivalry, and some hopes were even entertained that Mexico might see the wisdom of appropriating a sufficient sum of money to show her products. But that was practically all.

It was not realized at that time what a vast interest the policy of Pan-Americanism was to create within the few months following the organization of the Exposition Company. It is now assured that the countries of South and Central America will make large appropriations and erect splendid buildings, and the countries of North America will of course see to it that she is not overshadowed by the continent of the South. Already the Government of the United States, the Empire State, the Dominion of Canada, the Republic of Mexico, nearly a dozen of the Latin-American republics, the French colony of Guadeloupe, and a number of the States of the Union have officially accepted the invitations sent out some time ago, and some of the republics have made their appropriations and started the preliminary work.

Copyright, 1899, by Pan-American Exposition Company.

MACHINERY AND TRANSPORTATION.

It is true that still eighteen months must elapse before the gates of the great Exposition will be swung open to the oncoming throng of visitors, but there is no time to waste, for it takes time to erect State buildings; scour the commonwealth for all that is best and most interesting for a display, make the journey and install the exhibits.

It will all be a revelation to the visitors when they reach Buffalo in 1901, for the men at the head of the coming fair have made radical departures in the construction of the buildings and the laying out of the grounds, and the results will be startling in their beauty. The selected tract of land on which the buildings will stand embraces about 335 acres of the finest section of the city; 180 acres being the show portion of Delaware Park, the handsomest subdivision of Buffalo's very complete and handsome park system. To reach this ideal spot it is necessary to traverse the finest residential section of a city that is noted far and wide for the beauty of its homes and the magnificence of its avenues and boulevards, and the visitors will be spared the sight of the municipal back yard.

At the outset it was the intention of the management of the fair to expend an even million dollars in the construction of an exposition that would fit comfortably on Cayuga Island, a beautiful bit of land in Niagara River, a short four miles above the Cataract. This was the plan early in the year 1897, when the original Pan-American Exposition Company was organized. It was going along famously on those small lines, and the Federal Government and the government of the Empire State had been approached and had made promises for Legislative and Congressional aid. Then the Spanish-American war broke out, and it was decided that it would be unwise to ask the nation to aid any enterprise, be it ever so great, when the men of the nation were battling with a foreign power. Matters were held in abeyance for a time, and it was decided that the exposition should be postponed from the year 1899, when it was originally intended that it take place.

It was started again as a popular movement, and since that time its history has been a panegyric. With a rush over 12,000 of the men and women of the Niagara frontier signed for stock in amounts ranging from $10 to $25,000, and when the first financial rush was lulled, the company was standing upon a firm financial footing with nearly $1,500,000 available for the preliminary work and the construction of the buildings. Then the government and the Empire State appropriated respectively $500,000 and $300,000, and the New York State Legislature passed a bill increasing the capital stock from $1,000,000 to $2,500,000 and empowering the Board of Directors to float bonds in a similar amount.

Without delay the organization was completed by the election of Hon. John G. Milburn as president, John N. Scatcherd as chairman of the executive committee, Hon. John B. Weber as commissioner-general, George L. Williams as treasurer, and Edwin Fleming as secretary.

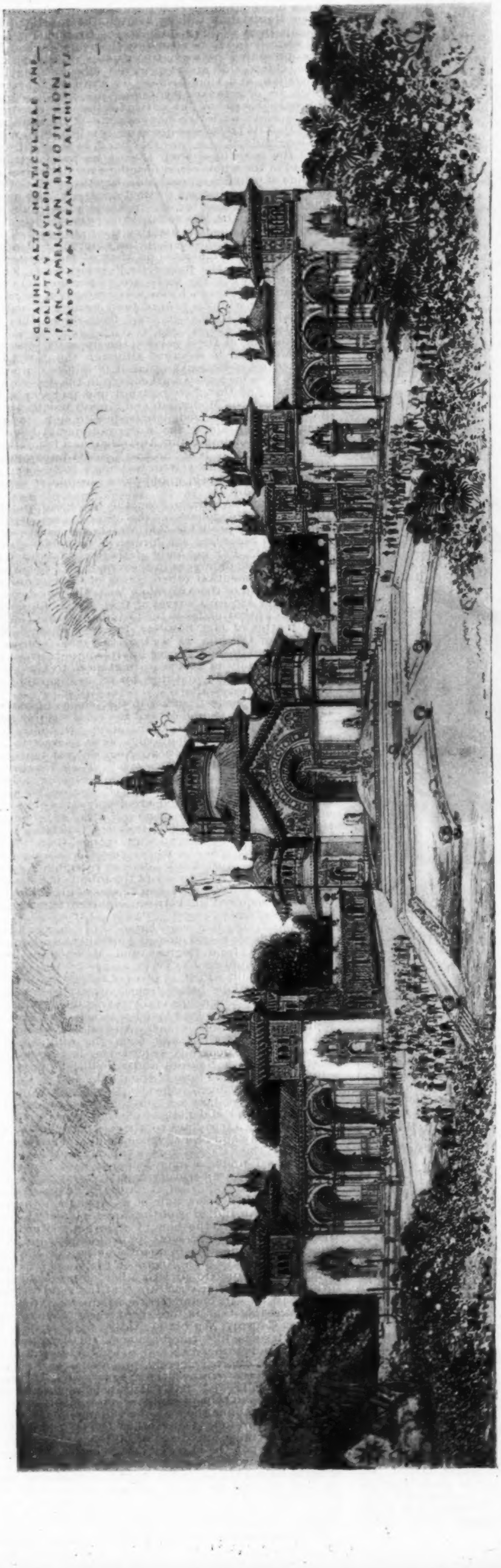
Following the selection of those gentlemen came the perfection of the bureau organization, and then Newcomb Carlton was appointed to the very important position of Director of Works and an Advisory Board of Architects was selected; the board being eight in number and made up of three of the famous architects of New York, two of Boston and three of Buffalo. Following came the selection of Hon. William J. Buchanan to the position of Director-General.

All have worked well since those earlier days, and at the present time the magnificent tract of land on which the fair will stand is undergoing an almost fairylike transformation. Day by day the great stretch of rolling meadow and grassy plain is being torn up, and where streets and paths and golf links formerly were, there is now a wonderful canal two miles in length being cut, and hundreds of men and teams with steam plows and loading machines are taking out acres of earth and forming the artistic hollows and pools for the numerous lagoons, water courts and lakes which will contribute so much to the artistic ensemble which is being sought and which will be attained. Within thirty days the magnificent Service Building was constructed, decorated and furnished, and Director Carlton with his Bureau chiefs and their army of assistants are now social recluses, for they are living in that building and are working like beavers to get the foundations down and have the work started on five of the other great buildings.

It is hoped and confidently expected that the Machinery and Transportation Buildings, the Electric Building, the Horticulture Building and the Graphic Arts Building will be under roof before the spring arrives, and during the summer these buildings will be finished and the work will be forwarded on the magnificent structures planned by the Supervising Architect of the Treasury Department of the Government, on the Roman Stadium and the Electric Tower, which will be the architectural chef d'ouvre of the entire fair.

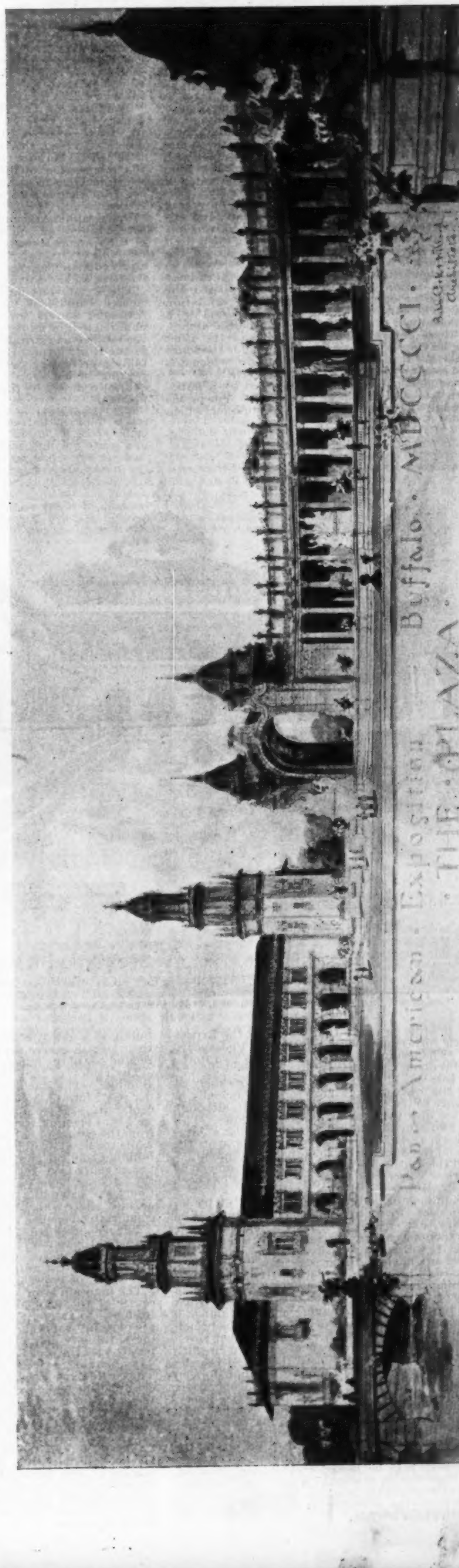
This grand structure, which will have the position of honor at the head of the Grand Court of Honor, will be the highest structure on the grounds and the most expensive and ornate. It will be about three hundred feet in height and will be a mass of fountains and electrical effects never before attempted.

It is but fitting that Buffalo and the Pan-American Exposition should do this on account of their proximity and close commercial relationship with the Niagara Cataract and Niagara's electric power. It is now assured that the energy of the great cataract will dominate the Exposition. Already the streets of the city in which the Exposition is located are lighted, the street cars of the International traction are propelled by the same power. In 1901 many of the leading industries of the city will be operated by



HORTICULTURE, GRAPHIC ARTS, AND FORESTRY.

Copyright, 1899, by Pan-American Exposition Company.



THE PLAZA.

Copyright, 1899, by Pan-American Exposition Company.

this power, and the entire Exposition machinery will be quickened by its influence.

A glance at the accompanying pictures of the first three buildings planned is convincing evidence of the fact that the management intends to invite the world to an exposition that shall be worthy of the occasion and of the city and country in which it is held.

THE BUILDINGS OF THE PAN-AMERICAN EXPOSITION OF 1901.

THE northern part of the exhibition ground is occupied by a square about 500 feet from east to west and 350 feet from north to south. The buildings bounding three sides of this square and the arrangement of the square itself have been given to Messrs. Babb, Cook & Willard, of New York, and the style adopted—a very free version of Spanish architecture—has suggested the name of the Plaza, which has been given it. The central portion of this square is occupied by a terrace only very slightly raised above the surface of the square, and surrounding a sunken garden, in the middle of which is a bandstand. The terrace as well as the garden itself will afford a large space for listeners who attend the concerts which it is proposed to give.

Outside, and at the north of the Plaza, is the railway and trolley station, from which it is supposed the greater number of visitors will enter the exhibition grounds. The railway station itself is masked by a colonnade flanked at either end by two colossal arches, one for those entering the Exposition and the other for those leaving it. This colonnade bounds the Plaza on the north. It is surrounded by a trellis, which it is proposed to cover with vines of various sorts.

The west side of the Plaza is bounded by a building which is to serve as a large restaurant. The public pass through the lower arches of this building, which are open, in order to reach that portion of the Exposition which corresponds with the Midway Plaisance at Chicago. The restaurant building itself is two stories high, and is about 350 feet long.

On the east side of the Plaza is a building closely resembling the restaurant, which serves principally as the entrance to the Stadium or athletic field, although portions are also used for exhibition purposes. This also has two stories, the upper story being a large open gallery, from which views of the Plaza on the one side and the Stadium on the other are afforded.

Finally, the south side of the Plaza is bounded by the Electrical Tower, the designing of which has been given to Mr. Howard.

The Stadium or athletic field has been in all its details a subject of careful study. It resembles in a general way that erected at Athens a few years ago, although this one can be, of course, only a temporary structure. It will contain easily 25,000 spectators, and is intended as a model of what it is hoped may be executed some day in permanent form. It has a quarter mile running track and a sufficiently large space in the inside of this for any of the athletic games. Great attention has been paid to having a large number of aisles to reach the seats, and in addition to the principal entrance on the west, there are provided seven large exits. These exits are made of sufficient breadth and height to admit in case of need the largest vehicles or floats, as it is proposed to use the Stadium for certain pageants, exhibits of automobiles in operation, judging of horses, live stock, agricultural machinery, road machinery, etc. No exhibitor has ever had such a splendid arena in which such exhibits can be displayed, and the athletic carnival to which the Stadium is particularly devoted is expected to be one of the most interesting features of the exhibition. The space under the seats is to be used for exhibition purposes, and is in itself the equivalent of a very large building.

The total length of the Stadium, including the building which forms the entrance, is about 870 feet, and the breadth about 500 feet.

The three buildings for horticulture, graphic arts, and forestry, of which Messrs. Peabody & Stearns are the architects, form a picturesque group at the end of the west garden.

The largest of these, the Horticultural Building, stands between the other two on an axis with the garden. The Forestry Building is on the north side; the Graphic Arts on the south, adjoining the lake. Arcades connect the three buildings, forming in front a semicircular court. Between the arcades the ground rises slightly to the level of the Fountain of the Seasons.

The area of the Horticultural Building is 45,000 square feet. The Graphic Arts and Forestry buildings each cover 30,000 square feet and are similar in design. In plan, the Horticultural Building is square, with central lantern, rising to a height of 240 feet at the intersection of the four arms of a Greek cross, which includes in its angles four small domes. On the center of each façade is a deeply recessed arched entrance.

The Graphic Arts and Forestry buildings have four corner towers, and on the east façade a vaulted loggia of three arches forms the main entrance. Above the red roofs of Spanish tile numerous lantern, pinnacles, and Venetian flagpoles, from which float gayly colored banners, add a festive picturesqueness to the skyline.

The broad white wall surfaces are ornamented with colored bass-reliefs. Arabesques of twining vines of fruit and flowers, among the branches of which are children and birds, decorate the numerous pilasters of the façades and arcades. Above the eastern entrance of the Horticultural Building are two colored compositions representing Ceres, the goddess of the harvest, bearing in her arms a sheaf of golden wheat. Her chariot is drawn by three lions led by Flora and Primavera.

The decoration of the Graphic Arts and Forestry buildings is chiefly confined to the vaulted ceilings of their loggias, where the brilliantly colored decorations remind one of the famous example of the Villa Madama.

COPYRIGHT, 1899, BY PAN-AMERICAN EXPOSITION CO.

The Court of the Machinery and Transportation Building.—The Machinery and Transportation Building itself forms a hollow square, with this Court in its center. It is 200 feet long and 100 feet wide, the east and west ends opening respectively to the great entrances from the Grand Canal and the Court of the Fountains, while the great exhibiting rooms of the Mall side of the building, and the two exhibition rooms and great entrance court from the Court of the Fountains side of the building, lie on either side. Along each side of this Court, and extending the entire length, are roof-covered arcades under which the visitors may find rest on the comfortable benches.

The pool itself is 175 feet long and 27 feet wide. It is placed in the center of the Court. The bank is sodded and planted on all sides, forming a pleasing frame or border effect; the water is low, so as to receive the reflection of the growth around the pool.

The fountain is an important feature, placed in the center of the pool, and giving life to the scene and freshness to the atmosphere. Throughout the Court are pleasant walks and paths, bordered with low-growing shrubbery and plants, and at intervals at axis-points with the arcades, rare plants are placed in great vases, making a truly architectural landscape effect. The entire scheme gives the effect of an admirable inclosure of a mission cloister, and is planned as one of the many little oases for the refreshment of the weary sightseer. This building and Court have been designed by Green & Wicks, of Buffalo.

Change in Venezuelan Mining Laws.—Consul Plumacher transmits from Maracaibo, under date of November 27, 1899, translation of a decree abolishing the resolution of October 20, 1898, as not in accordance with the mining code, which prescribes the exemption of duties on machinery and articles imported for the exploitation of mines.

THE NATIVES OF AUSTRALIA AND THEIR ORIGIN.

By R. LYDEKKER.

IF the visitor to the Natural History Museum at South Kensington direct his attention to a case in the upper Mammalian Gallery bearing the superscription "Comparison of Man and Apes: Craniometry," he will scarcely fail to be struck by the remarkable difference presented between the palates of three skulls placed side by side, and respectively labeled Mongolian, Australian, and Chimpanzee. In the first the teeth, which are of comparatively small size, form a regular, unbroken horseshoe-like curve, as they likewise do in a European; while the bony palate of the skull is so short that its transverse diameter considerably exceeds the longitudinal. On the other hand, in the Australian skull the individual teeth themselves are larger, and instead of the whole series forming a regular horseshoe, the line of grinders on each side, together with the eye-tooth, or canine, forms a distinct angle with the incisor line in front. Moreover, the palate is longer and narrower than in the Mongolian skull; the length of its longitudinal diameter exceeding the transverse. Turning to the Chimpanzee skull, the observer will notice that the features indicated in that of the Australian are intensified; the palate itself being much longer than broad, while the teeth are proportionately very large, and those on each side are arranged in a straight line, curving slightly inward, and forming a marked angle with the incisors in front, from which they are separated by a distinct gap.

Looking at the three palates, the impartial observer can scarcely fail to see that although the Australian is nearer to the Mongolian than it is to the Chimpanzee, yet it forms a very marked step in the direction of the latter, and that if we had but one more link, the gap between the Mongolian and Simian palates would be practically bridged. Indeed, although, judging from the skull alone, the European should have no hesitation in claiming the Australian as a fellow man, yet to say that he is a "brother" would be stretching that somewhat elastic term very hard indeed—an extremely distant cousin would more adequately express the relationship!

Had we only Australians on the one hand and Europeans and Mongolians on the other to deal with, it appears highly probable that we should be perfectly justified in regarding the former as a distinct species of mankind. For not only is there the above mentioned striking difference in the structure of the palate, but (not to mention other points of distinction) the spinal column of the Australian lacks the full development of the exquisite curves of that of the European, and thus approximates to the Chimpanzee and Gorilla. As a matter of fact, however, the frizzly-haired Melanesians of Oceania, as well as the true Negroes of Africa, stand in some degree intermediate between the Australian and the European in respect to the structure of the skeleton, and thus forbid us regarding the former as a species apart.

One of the greatest puzzles in the science of anthropology is indeed to understand the relationship of the Australians to other races of mankind. In their skeletal structure they undoubtedly come nearest to the Melanesians and the African Negroes, although presenting a still more primitive type. Their black complexion, thick and pouting lips, projecting jaws, large teeth, and long skulls are indeed essentially Negro characters. Their eyes, too, are deeply set in the skull, and their legs show little or no calf. In the prominent ridges over the eyes, they frequently exhibit a resemblance to the Melanesian rather than to the African Negro type, in which these brow-ridges are undeveloped. Australians likewise resemble Negroes in that the color of the skin of the infants is light yellow or brown instead of black; the adult sable tint not being acquired till between eighteen months and two years of age.

But (and this is a very large "but" indeed) here the resemblance ceases; for all Australians are broadly distinguished from Negroes and Malanesians—even their near neighbors the Tasmanians—by the character of their hair, which, in place of being "woolly," or frizzly as it may be better termed, is at most bushy, curly, or wavy; being generally coarse in texture and black in color. The beard and mustache are likewise well developed; and in fact, Australians cannot be distinguished by their hair from the wild tribes of India, who are generally regarded as having no near relationship with Negroes, and who display no markedly low type in the form of the palate.

Before attempting to consider the meaning of this marked difference between Australians on the one side and Negroes and Melanesians on the other, it may be well to devote a few lines to the essential distinction between frizzly and other types of hair. If sections be taken from the hair of a horse's tail or mane, and then be examined under a microscope or lens, it will be found that they are perfectly circular; and the entire hair being thus cylindrical, it naturally hangs straight down. The lank black hair of a Japanese, a Chinese or an American Indian is of the same cylindrical type. On the other hand, the hair of an average European when seen in section presents an oval ellipse, and thus causes the waviness so frequently noticeable. When, however, the hair of a Negro or Melanesian is sectionized, it is found to present a flat ellipse; and it is owing to this peculiar structure that the hair of these peoples assumes its characteristic frizziness. Now it is very noticeable that in crossbred races, such as the Brazilian Capesos (Negro and Native half-breeds, who are mop-headed like the Papuans), this frizziness of the hair tends to persist; and a hybrid described as half Negro, a quarter Cheroki, and a quarter English, is stated to have retained the Negro "wool." Hence it has been suggested that frizzly hair represents the primitive human type of capillary adornment.

But if we examine the hair of a Chimpanzee, Gorilla, Orang-utan, or indeed any other Old World Ape or Monkey, it will be found to be of the straight type, and to show not the slightest tendency to frizziness. Clearly then, from the evolutionary point of view, the straight-haired type ought to be the original one; and we find the late Sir W. H. Flower saying that the frizzly type "of hair is probably a specialization, for it seems very unlikely that it was the attribute of the common ancestors of the human race."

If this hypothesis be true, it would point to the con-

clusion that the Australians are a more primitive type than the Melanesians and Negroes; a view which receives strong support from the primitive characters presented by their skeletons. But it must be observed that Sir William Flower, in spite of the opinion expressed above, suggested that the Australians are a mixed race, derived from a crossing between frizzly-haired Melanesians and some low type of the Caucasian stock, such as the wild tribes of Southern India. It may be urged, however, from what has already been said in regard to its persistence among half-breeds, that the frizzly type of hair would be very unlikely to have so completely disappeared among the Australians; added to which is the circumstance that had such extensive crossing with the Caucasian stock taken place, the Australians could scarcely have preserved such an extremely low type of skeletal structure—a type which, at least as regards the palate and the spinal column, appears lower than that of either Melanesians or Negroes.

That the Australian aborigines reached their present home from southeastern Asia may be regarded as almost certain; and some have considered that the migration took place at a time when there was still a more or less complete land connection between Malaysia and Australia. Moreover, certain South Australian tribes are considered to be closely related to the ancient inhabitants of Europe, as typified by the famous Neanderthal skull. Hence there is nothing improbable in the supposition that both the Australians and the primitive Caucasian tribes of India are the descendants of a common stock, the Australians having retained the primitive character of their Neanderthal ancestors, while the Indian tribes have attained a higher grade of evolution.

On this view the frizzly-haired Melanesians and African Negroes, as well as in all probability the round-headed Negritos of Luzon, in the Philippines, would be descendants from the primitive stock of which the Australians are less modified representatives. And in this connection it is important to mention that Dr. O. Finsch, who has traveled much in Australia, is of opinion that the Australian aborigines form a single and peculiar race, which differs more from either typical Melanesians or Papuans than do both the latter from African Negroes.

The general physical similarity of the natives from all parts of Australia is indeed a very striking peculiarity of the race, and serves to show that, whatever be their origin and their relationship, they have been, previous to the European colonization of their island continent, isolated for an immense period of time from the rest of the human race.

Their unity of type and isolation from other races is strongly emphasized by their language, which, while uniform throughout the country, is at the same time quite distinct from that of any other people. It has indeed been attempted to connect the Australian tongue with that of the Dravidian races of Southern India, but this, according to recognized experts, is stated to have resulted in a total failure.

There is, however, a very curious connection between the Australian aborigines and certain of the wild tribes of Southern India, namely, that both possess the boomerang; a weapon unknown to any other members of the human race.* Of course, there is the possibility that this very remarkable implement has been independently invented by the two people who use it, but there is a considerable degree of improbability in this idea. If, on the other hand, it be an inheritance of the Australians from Asiatic ancestors, it may be fairly argued that it is unlikely to have been evolved at the extremely remote epoch when the ancestral Australians started from their Asiatic home. And if this view be accepted, then we are compelled to revert to the idea of a later immigration from Asia, which brings us again to the question of the origin of the wavy hair of the Australians.

Apparently there is no possibility of giving a definite answer as to the origin of the boomerang; but there is one very curious point which may indicate the great antiquity of its introduction. As most of my readers are aware, the Australian aborigines possess a semi-domesticated dog—the Dingo; and there are strong reasons for regarding this animal as not pertaining to the indigenous fauna of the country. Its remains are, however, met with in association with those of a number of extinct animals, so that the date of its introduction was evidently very early. But if, as some suppose, man reached Australia at a time when it was much more closely connected with Malaysia than is at present the case, his advent might well have been contemporaneous with that of the Dingo. And here comes in the point referred to, namely, that (as I learn from an expert) the Dingo is very closely related to the Paria dogs of India. Now since these latter are domesticated breeds, the evidence, if it may be relied on, points to a very early immigration into Australia of aboriginal tribes accompanied by dogs from Asia. And if such early aborigines had domesticated a dog, they might surely be deemed capable of having invented the boomerang.

Like all tribes who have been brought into connection with Europeans, the Australian aborigines, especially in the districts longest colonized, have altered—and frequently for the worse—from their primitive condition; while they have also sadly diminished in number. Writing, under the pseudonym of "An Old Bushman," so long ago as 1860, an observant settler in the vicinity of Melbourne made the following remarks:

"Of the many thousands who inhabited the colony before the arrival of the white man, not 2,000 survive, and most of these are on the banks of the Murray. Although debased far below their own savage level since their intercourse with the white man, the few that are left still retain much of that free independent spirit and wild roving disposition which characterize all savages who have to get their living by the chase. For although they get their rations all the year round at the head station, they never care to live long in one place; but, following up the habits of their early life, make periodical excursions into the bush at different seasons, when the different game is in. Thus swans' eggs, kangaroo, ducks, eels, and crayfish, all furnish them with food and occupation at different seasons."

The procuring of a sufficient supply of food is indeed the great problem of the life of the aboriginal Australian; especially as his weapons, with the exception of the boomerang, are of an extremely poor description. Consequently, these people, if we may judge from the accounts of those who have had the best opportunities of observing them, are some of the best, if not actually the best hunters and trackers in the world; indeed, Dr. Semon unhesitatingly assigns to them the highest position in this respect. Nothing that can be in any way regarded as edible seems to come amiss to an Australian, even such unsatisfactory morsels as grasshoppers, beetles, and fleas being consumed with relish. Probably the difficulty of obtaining a sufficient food supply from other sources was originally the reason that cannibalism came into vogue, but when once established it assumed a prominent place, Dr. Lumholtz telling us that human flesh is the greatest dietary luxury that these people in their primitive condition enjoy.

In the proper sense of the term the Australian appears to have no religion at all; at any rate it has been authoritatively stated that he has never been observed either to pray, worship, or offer sacrifice, and that in his natural condition he has no sort of conception of a future state of existence. His extremely low grade of development is likewise strikingly exemplified by the treatment accorded to the female sex—a treatment perhaps only paralleled among the Fuegians. Such of my readers as wish to learn how brutal this treatment is, may refer to the works of Dr. Semon and Mr. Brough Smyth; but no good object would be gained by quoting the pitiful details in this place. Neither need detailed reference be made to the complicated system of class marriages which obtains among certain of the tribes. Although under a careful system of education in European schools the native children are capable of acquiring a certain amount of knowledge, displaying a decided capacity for drawing, there can be no doubt that the mental capacity of the Australian in his primitive condition stands at an extremely low level. No better exemplification of this can be cited than his arithmetical capacity—or rather incapacity. So low indeed does he stand in this respect, that none of the tribes have a word to express a number higher than three, while some content themselves with those for one and two. Mr. E. M. Carr is of opinion that no uninstructed Australian native can by any possibility count even as high as seven correctly. "If you lay seven pins on a table," he writes, "for a black to reckon, and then abstract two, he would not miss them. If one were removed, he would miss it, because his manner of counting by ones and twos amounts to the same as if he reckoned by odds and evens." It is difficult to imagine anything much lower than this.

Perhaps their one redeeming quality is their honesty and truthfulness; the "Old Bushman" stating that though they will ask for any article that may take their fancy, as if they had a right to it, yet that he never knew them to steal. All who have had much intercourse with them agree that they are naturally a merry and humorous people, with a great capacity for mimicry, taking off with facility any peculiar personal mannerism of those with whom they may be brought in contact, or imitating the movements of the kangaroo and the emu.

To work of all kinds they have a rooted objection, and the writer last mentioned gives it as his opinion that it would be impossible to make a slave of an Australian Black. Nevertheless, if I may judge from certain photographs lent me by Mr. B. Woodward, of the Perth Museum, the aborigines remaining in the settled districts do now perform a certain amount of labor. They have also taken to European clothing—of sorts. But, to quote once more from the "Old Bushman," the Australian ladies, who are by no means remarkable for personal beauty, at least from a European standpoint, "seem to care nothing for finery or ornaments, a dirty blanket or opossum-rug wrapped loosely round them, and a short black pipe stuck in their hair completes their toilet." Not improbably my lady readers will consider this a more convincing proof of the low grade of the Australian aborigines than any other instance that could be mentioned!

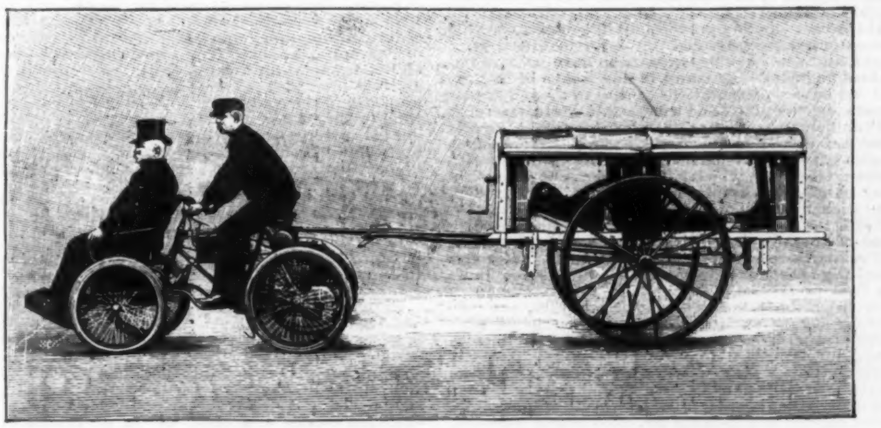
Since writing the above, I have had an opportunity of carefully reading Dr. Semon's book, "In the Australian Bush," and am pleased to find that he agrees with the views here expressed as to the racial distinctness of the Australian aborigines from their neighbors. But he goes a step further than I have ventured to advance, and suggests that the Australians are really near relations of the Veddas of Ceylon, and are therefore in reality a low branch of the primitive Caucasian stock, and have nothing to do with Negroes, to whom they are commonly affiliated.

* The boomerang of India has not the return flight of the Australian weapon.

AUTOMOBILISM IN HOSPITAL SERVICE.

THE applications of automobilism in public services are rapidly multiplying. The city of Alençon has recently been trying an interesting innovation in the way of a "Service of Prompt Relief," which really merits its name. To a quadricycle is harnessed an ambulance vehicle of the Lagogue system. If it is a question of going to afford relief to a person wounded in the country, at several miles from the city, the driver goes for the surgeon, who takes his seat in front of the quadricle. Thus carried to the spot, the surgeon immediately gives the patient all the attention that is necessary for the moment, and then has him placed in the ambulance, which carries him to the hospital of Alençon.

For the above particulars and the engraving, we are indebted to L'Illustration.



QUADRICYCLE HAULING AN AMBULANCE.

ANCIENT EGYPTIAN GARDENING.

WRITING for The Gardeners' Chronicle, Mr. Percy E. Newberry gives the following description of gardening 6,000 years ago. Although the Egyptian soil is extremely fertile, it is a remarkable fact that no country in the same latitude has so poor a variety of indigenous plants. Wild flowers are rare; native trees are few. Owing to the annual inundation of the Nile, much of the land is under water for nearly four months in every year; for another four months the valley is green with growing crops, or golden with ripening corn, and the remaining four months of the year the surface of the soil is bare, parched and baked by the burning sun. Of natural shade there is very little. The commonest trees that are met with at the present day on a journey up the Nile are the Acacia Nilotica (the Sunt tree of the Arabs), the Date Palm, the Dûm Palm, the Nebak (Zisyphus spina Christi), the Parkinsonia, or Wild Seseban, and the Tamarisk, none of which trees produce much shade. The only tree of any size bearing dense foliage is the wild Fig, or Sycamore (the Gimmez of the Arabs), which grows here and there in an isolated fashion. Yet if there be a country where the cool shade of trees is required, that country is Egypt. The native inhabitant longs for it as much as the foreign resident, and during the midday heat of spring, summer and autumn, when the sky is always cloudless, the observing eye will note that the fellaheen men and boys utilize every available shady corner. The ancient Egyptian must have equally felt this need of a cool place wherein he might take his noonday siesta, and with this object in view he undoubtedly first planted trees around his house. Numberless inscriptions record the prayer that a man might sit in the shade of his Sycamores and "inhale the sweet, cooling breeze of the north wind."

The most ancient description of a garden that has come down to us plainly shows that when the garden was laid out, the chief object of the designer was to make a shady place to sit in. This description, written in hieroglyphic writing, was discovered in a tomb near Abuser, a little village not far from the modern city of Cairo. According to the inscriptions in the tomb, the garden belonged to a certain wealthy noble named Amten, who owned several landed estates. At the outset of his career, his father obtained for him a government appointment connected with the Administration of Provisions, and it was Amten's duty to receive, register, and distribute the meat, bread, fruits, and fresh vegetables, which in those early days constituted part of the government taxes. While still a young man, he became director of the Royal Flax, which meant that he supervised its culture, cutting, and general preparation for the manufacture of linen. Later in life he was appointed to the rank of a Provincial Governor, and became rich enough to build for himself a magnificent villa upon one of his own estates. Of the garden which he laid out around this villa he has left us a remarkable description, which, though brief, is nevertheless of great interest, as being by far the oldest record of a garden yet discovered. "The boundary wall," he writes, "was 200 cubits (i. e., 350 feet) in breadth, and the same in width; the garden inside it was planted with beautiful trees, and a very great pond was excavated in its center, the surrounding garden being planted with fig-trees and vines." When the "writing for the royal rescript had been made, a very great vineyard was planted, which yielded me wine in great quantity. I trained two acres of vine hidden in the interior of the wall, and I planted trees around it."

It will be noticed that only two kinds of tree are mentioned. The first is the Fig-tree, called dab in this early inscription, but in later writings invariably named nehat or the tree par excellence—that is, the shade-giving tree of the country. The second is the vine, called aareret, from a word, aar, meaning "to

bind," "to twist round," "to twine," showing that the Egyptian name of the vine has the same etymological sense as our European word vinum. In hieroglyphics a word was often written with two distinct groups of signs, one group having phonetic—that is sound—values, the other ideographic or picture values. Sometimes these picture signs have simply a general meaning; at other times they have specific meanings. To illustrate this let us take the ancient Egyptian name of the Lotus, or Water-Lily, which may be written in two different ways. In both examples the word is spelt out—that is, it has three sound signs—(1) a line with two strokes in the middle, which is equivalent to our s; (2) a rectangular sign, representing a tank, equivalent to our sh; and (3) a zigzag sign, equaling our n. These three sound signs give the sound of the word—seshen. The last sign of the two examples of the word, however, differ. The three flowers attached to one stem in the first example is a general picture sign, which may be placed at the end of all flower or plant names, and merely means "a flower," or "any kind of plant;" but the sound signs before it fix its precise meaning—that is, it is the seshen-flower or plant. In the second example, we see the last sign is a Water-Lily, thus proving beyond all doubt that the seshen was the Water-Lily. In the case of tree-names, the generic picture-sign (or determinative, as it is technically called) is a pointed tree, somewhat like a Cypress tree. Sometimes, however, merely a single branch of a tree is used as a determinative, though this latter sign is generally confined to such trees as supplied the ancient carpenters with good wood for building or other purposes, and not to fruit-bearing trees. The names of fruits, likewise, are determined generally by three little round balls, or a number of balls in a basket. The names of grains, also, are determined by three grains of wheat or a number of grains in a basket. From the above-mentioned examples the reader will have obtained some idea as to the system of old Egyptian writing, and the use of picture-signs or determinatives.

In the inscription describing Amten's garden, the word for a vineyard is determined by a little picture of a vine growing over three upright forked stakes, from between which hang two fine bunches of grapes. This shows that the vines were trained as at the present day in Egypt and in Italy, over stakes, so as to form a shady arbor. At Luxor, I myself had a vineyard nearly two acres in extent of this type; and in summer time, when the vine leaves form a thick impenetrable shade, this was by far the coolest place in a well-stocked orchard and garden.

At the time of the pyramid-building kings, the vine was extensively cultivated in different districts of Egypt, and wine making appears to have been an important industry. In many of the tombs of this period we have representations of vineyards and scenes illustrating the process of wine making. In the tomb of Ptah-hetep at Sakkara (15 miles south of Cairo) is preserved a series of scenes of this kind. We see first of all a gardener named Ahy watering the roots of a trellised vine, from which two men and a boy are gathering bunches of grapes, and carefully placing them into wicker or Palm-leaf baskets. The inscription above them reads, "Plucking grapes." Following this scene is another, showing the treading of the grapes, and it is curious to note that among them is a professional wig-maker or hair-dresser. A third scene shows the final process of wine making, the extraction of juice from the pulp. The latter has been put into a strong bag with a loop at either end, a pole has been passed through each of the loops, and the juice is wrung out with great force by five persons. As early as 3500 B. C., six sorts of wines were made, and in the inscriptions we read of red, white, and black wines, as well as northern wine from the Delta provinces of Lower Egypt; and Sunu wine, from grapes grown at Assuan, in Upper Egypt. One of the favorite kinds was the Amt-wine, grown in the neighborhood of Nebesheh, a town in the Delta, some distance to the north-east of Cairo.

Another important industry in ancient Egypt was the cultivation of the Papyrus plant for the manufacture of papyrus paper. It was grown in the marshes, and there are several scenes preserved in the tombs showing the Papyrus harvest. It seems to have been chiefly cultivated in Northern Egypt, and in the hieroglyphic writing a Papyrus plant with three stalks signifies Lower Egypt, or the marshy district of the Delta. The corresponding sign for Upper Egypt was a Rush-like plant, perhaps some variety of Scirpus.

In the lists of offerings which are written upon the walls of some of the early tombs, the cultivated fig, the wild or sycamore-fig, the nebak (Zisyphus spina Christi) fruit, of which a kind of bread was made, the Balanites ægyptiaca, and some other fruits, are mentioned. The onion, called hez, "the white vegetable," was extensively grown, and perhaps also the radish. Several kinds of grain are named, including the durrah (Sorghum vulgaris), and wheat and barley. The names of localities and estates were often, as with us in Europe, taken from the names of trees or plants, and among these we find at the earliest historical period the "village of the vine," the "village of the barley," the "heglig (Balanites ægyptiaca) town," the "Fig-tree town," and so forth.

A side-light is thrown upon the gardens of the Nubians at this period from a passage in the Inscription of the General Una. He tells us that in one of his expeditions beyond the southern frontier of Egypt, he "cut down the Vines and Fig-trees of the outer barbarians." This general, according to his lengthy biography, which has luckily been preserved almost intact to the present time, began his career as one of Pharaoh's gardeners. Born late in the reign of King Unas (about 3,500 years before the Christian era), this remarkable man tells us that he wore the flower-crown of a boy courtier under King Teta, by whom he was appointed to the post of overseer of one of the royal storehouses, at the same time acting as under-gardener to the king. Then, after serving some time as a courtier and an under-priest, he was, curiously enough, appointed judge. So much esteemed was he, that he was ordered by the king to try, "alone with the chief justice and prime minister," several important legal cases, because, as he naively tells us, "the king's heart was satisfied with me more than with any of his princes, his officers, or his servants." For the services which he rendered in this connection, he was rewarded by the magnificent gift of a specially prepared sarcophagus and material to build a fine tomb for himself—a present which may seem strange to our eyes, but was one of the greatest honors that an Egyptian could receive at the hands of his monarch. During the time that he acted as a judge he probably still retained his office as gardener, for he writes: "Now when I was a judge, his majesty made me superintendent of the garden of Pharaoh, and I instructed the overseers of the garden that were there." While still a comparatively young man, he was commanded by the king to inquire into certain matters connected with what appears to have been a conspiracy against the life of the ruler of the state. Concluding this inquiry to the king's satisfaction, he was soon after given even more important duties to perform than any of the preceding. For the safety of the kingdom it was necessary to organize an expedition against the tribes on the southern frontier, and Una was sent at the head of a great army of many tens of thousands. "I it was," writes the autobiographer, "who planned their procedure, although my grade was that of superintendent of Pharaoh's garden." The expedition was successful, and the general returned to Egypt covered with glory, and was promoted to one of the highest administrative positions in the country, the whole of Southern Egypt, from the first cataract to the Fayum, being placed under his jurisdiction. Such was the eventful career of one whose "grade," as he expresses it, was at first no higher than that of an "under-gardener" to Pharaoh.

FIG. 3.—ROBERT HOUDIN'S CLOCK.

MYSTERIOUS CLOCKS.

IN all times certain clockmakers, fond of what is odd, have endeavored to conceal the movements of clocks to as great a degree as possible, in order to make their operation a matter of more or less mystery.

In the timepieces that we are about to describe, it has been the desire to give the illusion of hands moving of themselves. Attempts to accomplish this were made as long ago as the sixteenth century, and the clock which we represent in Fig. 1, and which belongs to M. Paul Garnier, is a very curious and pleasing type of such devices. It is 8 inches in height, is made entirely of gilded copper, and seems to be of Italian origin. The hour is marked by the small style seen at *A*. This style, which is cut out of steel, is carried along simply by a wheel concealed between the two disks that serve as dials and upon which it is fixed.

FIG. 1.—MYSTERIOUS CLOCK OF THE SEVENTEENTH CENTURY.

This small Renaissance clock, in the form of a monstrance, is one of the kinds that were placed upon a table; and so, like the majority of its congeners, it has two dials, in order that the time may be seen on each side. As the time is necessarily indicated by the same pointer, the hours on each disk are engraved in a different direction. So it will be seen from the figure, which shows the posterior face of the piece, that the number 1, for example, is at the place usually occupied by 11.

The little figure that indicates the quarters engraved around the sphere upon which it stands is very curious. But the interest of the thing is not centered here, since this combination conforms with the very frequent use of two dials on the clocks of this epoch—one for the hours and the other for the quarters. The illusion consists especially in the method of transmission of the wheelwork placed in the base of the piece. It would seem as if the vertical rod that supports the sphere would prevent the wheel concealed between the disks from revolving, since, through its position, the rod seems to intersect it. In reality it is the contrary that occurs, since the rod moves the wheel through the intermedium of a pinion that gears with it. The ratio between the teeth of the pinion and those of the wheel is such that the sphere makes one revolution an hour, while the wheel that carries along the pointer makes its revolution but once in the twenty-four hours into which the dial is divided.

In Fig. 2 we give a reproduction of a time piece dating back to the eighteenth century. It is 24 inches in height. The figure that supports it is of sculptured and gilded wood. Upon the dial, which is of copper, there are twelve enameled faces upon which the hours are painted. The handle of the inverted scythe held by Time is so arranged as to serve, together with a tree trunk placed behind the figure, as a support for the axis upon which the single hand is mounted. This axis is broken. The posterior portion is fixed in an aperture in the tree, and to it is keyed a toothed wheel.

The anterior part, which is movable, and carries the hand, is connected with a drum which envelops the toothed wheel and upon which is fixed a second and larger drum inclosing the movement. This latter gears with the fixed toothed wheel. So the movement, resting upon the fixed toothed wheel, describes a satellite motion around the latter and carries with it the two interdependent drums, the movable part of the axis, and consequently the hand.

Independently of this curious function, the clock maker has complicated matters through the two dials that are seen at each extremity of the hand. One of these marks the day of the month and the other the days of the week.

Behind each dial there is a box containing the motive system of the hands. This is exceedingly simple and the same for both. It consists of a central, toothed wheel upon the axis of which is fixed the hand, and which is set in operation by a pinion upon which is fixed a relatively heavy mass of metal. The large central needle makes one revolution around its dial in twelve hours; and the pinion being free and always held vertically by its weight, makes also one complete revolution, and consequently causes the wheel that it controls to turn forward. It is then only a question of the ratio between the number of teeth of the pinion and the wheel carrying the hand that determines the indication by the latter of the day of the week or day of the month. The two boxes with their dials and their weights are very well balanced, so that the watch movement which carries along the whole operates very easily.

Fig. 3 represents a clock invented by Robert Houdin about sixty years ago. This very remarkable time-piece consists of a dial composed of two juxtaposed disks of glass, one of which is stationary and carries the hours, while the other is movable and serves for the motion of the hands. This latter disk is provided with a wheel or rather a toothed ring concealed within the metallic ring forming a dial. The glass column which constitutes the body of the piece is formed of two tubes which operate according to the principle of the dial, that is to say, one is stationary and the other movable. To each of the extremities of the latter is fixed a wheel. These wheels gear with transmission pinions which communicate, one of them at the top with the movable plate of glass of the dial, and the other at the bottom with the movement placed in the wooden base which

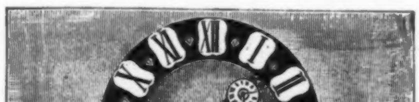


FIG. 2.—MYSTERIOUS CLOCK OF THE EIGHTEENTH CENTURY.

supports the glass shade covering the clock. All these concealed transmissions are arranged in a most skilful manner, and complete the illusion. The movable glass of the dial, carried along by the column, actuates a small dial-train mounted in the thickness of the stationary glass, and within an extremely narrow space in the center of the dial. It is covered by the small hand and is consequently invisible. The hands are very easily actuated by it on account of their extreme lightness and perfect equilibrium. We therefore find, at two centuries apart, in the examples just given, the same tendency toward making mysterious clocks.

Undoubtedly, from a decorative point of view, the most beautiful one is the most ancient, but the two others are none the less interesting, and in no respect less ingenious than the former, especially the last one described, which is indeed a marvel of its kind.

For the engravings and the above particulars we are indebted to La Nature.

LATTICE REFRIGERATORIES.

FOR the economical cooling of warm water, many industrial establishments employ open work refrigeratories derived from the well known fagot type, in which the water, divided into thin streams or even into drops, flows upward through ascending currents of air.

Owing to their power, such refrigeratories occupy considerable space and are quite costly to establish.

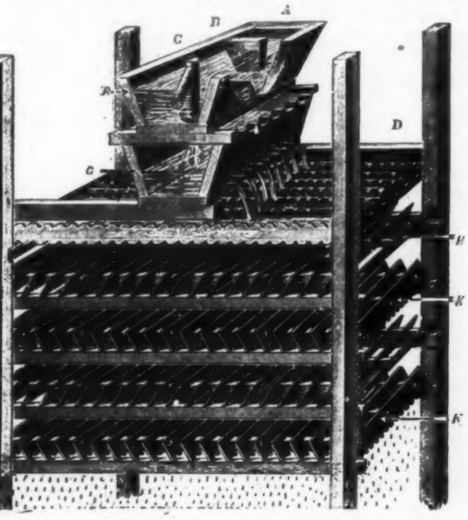


FIG. 1.—SECTION OF A ZSCHOCKE LATTICE REFRIGERATORY

Moreover, the materials of which they are constructed do not resist the destructive action of the water as long as might be desired, and the repairs to them are not very easy by reason of the difficulty of access to the interior of the structure.

Some important improvements have already been made from this point of view, and the occasion now presents itself to make known to our readers a new lattice refrigeratory for cooling the warm water of industrial establishments, recently introduced by the well known inventor, M. Zschocke. As is well known, lattice refrigeratories are used particularly in large manufactories in which steam is the motive force, and which employ, of course, economic engines operating in company with condensers.

When the water of a distributing service is expensive or the local services render the storage of it difficult, it is of interest to use anew the water of condensation, after it has been properly cooled.

The Zschocke apparatus is not only an efficacious refrigerator, but also a separator of the oil and grease carried along with the condensed steam. It consists of similar sections joined together in numbers varying

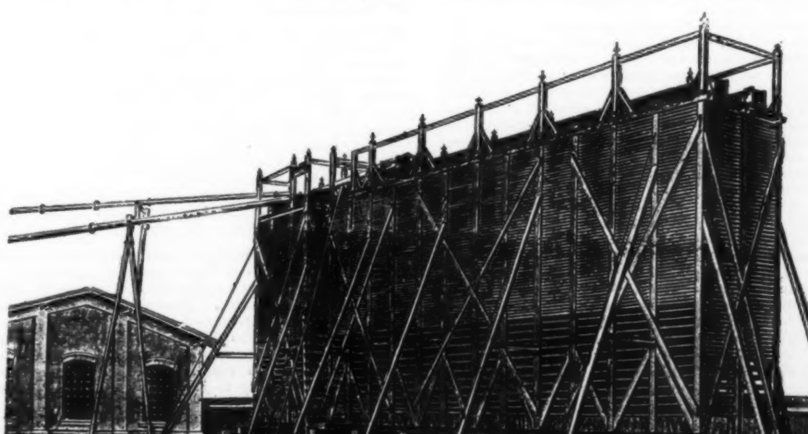


FIG. 2.—OPEN REFRIGERATORY.

with the quantity of warm water to be treated. One of these sections is represented in Fig. 1. The water that enters at the upper part is distributed uniformly in thin sheets over very wide surfaces of refrigeration, whence it flows in small drops submitted to contact with the air circulating freely in an opposite direction. This water is lifted by a pump and emptied through a pipe at *A* into the oil separator, *R*. A partial partition, *B*, breaks the current, while a barrier (rendered visible in the figure through the removal of a portion of the side of the trough) permits the oily substances to rise to the surface of the water, which overflows in front. Here the bottom of the trough is traversed by a vertical pipe, *C*, open at the top and provided with two oblique lateral tubulures, that enter the water to a medium depth, so that neither the oil on the surface nor the mud or sand at the bottom can enter the tubulures. The water drawn off through this pipe flows into the lower trough, *G*, which, through small iron tubes arranged at the sides of its base, empties it in jets into narrow distributing channels, *D*. To each pair of tubes there corresponds a channel that extends over the entire width of the apparatus and the walls of which are notched at the top and bottom in such a way as to allow the water to fall drop by drop upon screens arranged beneath.

As this water is deprived of oily matter, it gives rise to none of the well known inconveniences in the condenser, and does not foul the screens, which otherwise would soon lose their refrigerating efficiency, since, upon an oily surface, water rolls in large drops. The oil is extracted from time to time, and, after being filtered, may be used over again.

Mountain pine is exclusively employed in the construction of the screens. This wood, it seems, presents a greater resistance to the action of the air and humidity than fir.

The screens are formed of several sections, each having five lattices assembled obliquely and resting upon strips of wood fixed to the framework. The lattices are notched at their lower part. The water spreads over their surfaces and then unites in drops that flow over the screens placed immediately beneath. As may

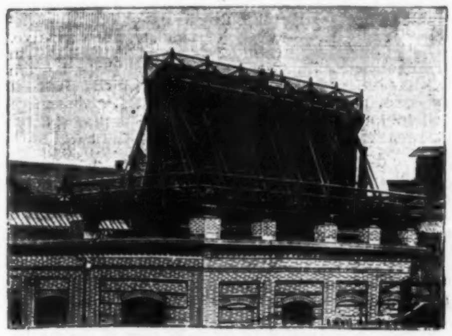


FIG. 3.—AN OPEN REFRIGERATORY INSTALLED UPON A ROOF.

be seen, the elements, *K*, of the second row of screens are parallel with those of the first, *H*, and are obliqued in the opposite direction; and the same is the case in the other rows.

The water that flows over the wide surface of refrigeration thus formed gives rise to a fine shower, which meets with ascending currents of air broken between the lattices. The result is an active evaporation which removes the heat not only from the thin sheets of water spread over the lattices, but also from the drops during their descent. The external walls of this refrigeratory are formed of overlapping slats, as in Venetian blinds, which, while allowing the air to enter freely, reduce the loss caused by removal of water to the exterior by the wind.

Fig. 2 represents an "open" lattice refrigeratory as a whole. At the municipal electric works of Kaiserslauten, which uses a 796 horse power engine, the water of condensation enters an apparatus of this kind at a temperature of from 50° to 56° C. and makes its exit therefrom at a temperature very slightly exceeding that of air in the shade. In summer it even descends a little below the surrounding temperature.

When space is wanting, it is possible at the time of the construction of the buildings of a manufactory to arrange the one containing the engines in such a way that an "open" or "closed" refrigeratory may be placed upon the roof (Fig. 3). In such a case the forcing of the water absorbs about 30 per cent. of the power of the motor with an injection condenser and only 10 per cent. with a surface condenser.

This solution of the question is adopted only exceptionally. In fact, it is very rarely the case that the necessary space is not found for a "closed" refrigeratory (Fig. 4), which, with a limited surface, presents great efficiency. The internal arrangements therein are like those that we have described, but the framework is closed all around by boards, and at the top there is a draught shaft which operates after the manner of a chimney.

The closed refrigeratory may likewise be installed in small yards in which there are no natural currents of air. A sufficient height is given to the chimney to allow the vapors to be disengaged above the surrounding buildings. The loss of water through being carried away by the wind is here completely prevented. For the forcing of the water only 10 per cent. of the power of the motor is reckoned, with the chimney refrigeratory installed upon the ground, whatever be the system of condenser.

For the above particulars and the engravings we are indebted to La Revue Industrielle.

RECORDING FERN SHAPES.

MOST of those whose inclination leads them much afield find at times bits of Nature's tracery in an oddly marked leaf or rare fern, which appeals to their sense of the beautiful, says a writer in The Evening Post. They have a desire to preserve these specimens, but the memory of things of this kind brought home from excursions and pressed between the leaves of a book, only to be marred or destroyed, usually causes them to abandon this idea. There is one way, however, in which a faithful representation of these objects may be secured, a way at once interesting and instructive. This is by using the leaf or fern as a negative; that is, laying it on a sheet of photographic printing paper, and exposing it in a printing frame in the ordinary way to the action of the sun. The equipment necessary to set up as an adept at this little fad in amateur photography is inexpensive and easily procured, being as follows: A printing frame, 4 × 5 or 6 × 8; a pair of scissors, a dozen sheets of printing paper, a piece of soft cloth, and a good book. Those who have even the slightest knowledge of amateur photography will understand from what has already been written how to obtain prints in the manner mentioned, while those not so qualified can become easily skilled in making them by following the hints here given.

When you next go for a ramble along the river or on the hills, take the articles noted above. The printing frame should have a weaker spring than those used for ordinary work, so as not to cause pressure enough on the green things placed in it to force the sap from them. Whatever kind of printing paper is selected, choose the best grade of that particular kind. The scissors should have blunt ends, so as to do away with any chance of injury in case of a fall while scrambling up a bank after a choice fern. They will come in handy to cut the paper into the required size for small leaves. The cloth is to clean the glass of the frame, and the leaf or fern before the print is made. The use of the book will appear later.

The leaves which yield the prettiest prints are those of the sumach, oak, elm, wild rose, cherry, and the raspberries; while ferns, of all things, lend themselves to the pastime most readily. They are, however, from their delicate nature, harder to handle than leaves, which the beginner should print from at first.

When you have made up your mind on what leaf you wish to try your skill and patience, do not seek to secure it from a large tree, as most of the leaves on large trees, being much exposed to the stings of

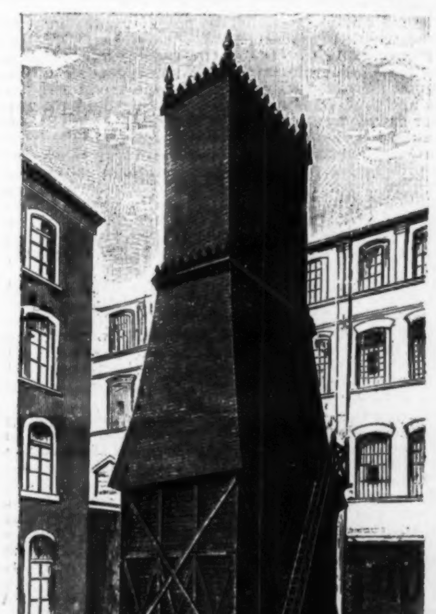


FIG. 4.—CHIMNEY REFRIGERATORY.

insects and the action of the sun, become spotted or stained by the time they are advanced enough to be handled without danger of abrasion. In the underbrush near at hand you will find some lusty scion of the tree you have decided upon, which, being sheltered by its parent from all the ills that have vexed the latter, has retained its springtime freshness. Having made your selection from this, the print should be made as quickly thereafter as practicable, as the leaf will soon lose its crisp appearance.

Retire to the shadow of a large tree trunk, stump, or other shield from the sun, and lay the book on the ground for a resting place for the printing frame. Open the frame and make sure that the glass is free from dust. Wipe the leaf carefully and place it on the

glass, face down, in the position your taste dictates as likely to yield the most pleasing result. Open the envelope which contains the printing paper (which should always be guarded as much as possible from the light), and take out a sheet face down. Place this on the leaf in the frame, the under side of the leaf always in contact with the face of the paper. Do this as quickly as possible, and do not turn the frame face upward until it is locked. Having arranged matters to your satisfaction, find a spot where the sun comes through the leaves and place the frame face up in the direct light of its rays. Then sit down and read from your book while the sun does the work. From two to ten minutes will be required to secure a good print, according to the time of day and thickness of the leaf or fern. Of the leaves, the oak prints quickest, while the elm and raspberry take somewhat longer. The ferns all print very quickly, the maidenhair resisting the action of the light least of all.

Take the print from the frame with the same precautions used in placing it there, and put it between the leaves of the book or in a separate envelope to guard it from the light.

The prints may be toned in the ordinary way. If you have not time to do this, any professional will be glad to run them through with his regular work for a comparatively small sum. Mounted, they will form a pleasing collection to turn to on a winter's day, while if dried out on a ferrotype plate, they may be used for decorative purposes in numberless ways, as the owner's taste may suggest. They will be permanent if made on good paper, and will not be subject to the same danger from rough handling that pressed leaves and ferns are. And, best of all, if you are a collector of ferns, when you write to a brother or sister enthusiast telling of a scramble up a cliff or search through the underbrush after some rare specimen, you can wind up your eulogistic description of it with the P. S.—"I inclose herewith a print, which will enable you to form some faint idea of the beauty of the original."

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Automobiles and Electric Power Plants in Sweden.—Many business men here think that the import of motor carriages into Sweden, if once properly started, will be considerable, provided they can be made durable, neat in appearance, safe and easy to handle, and not too expensive, says United States Consul Robert S. S. Bergh. Cab owners, especially in Stockholm, are considering the advisability of purchasing motor carriages, and a short time ago they sent experts to Berlin, to study and examine motor cabs manufactured in Germany. The report they made on their return was not altogether favorable. They said that automobiles which in catalogues seemed to be ideals of perfection, in reality did not come up to expectations.

The chief objection to the motor cabs, with accumulators or storage batteries, was that they could not make sharp enough turns. The cabs were built with the batteries placed close to the back wheels. The steering power of the front wheels was so small that the carriages could turn only in very large curves, making them unfit for use on narrow streets. Another inconvenience was that as soon as the cabs got on a road covered with a layer of sand an inch thick, they stopped helplessly.

Besides these inconveniences, common to French and German motor cabs alike, it was said that few of the carriages exhibited were of the type desired—that is, with room for from two to four passengers. Hunting wagons, motor cycles, delivery wagons, etc., for sportsmen and business houses were plentiful; but cabs were fewer and, as a rule, clumsy in appearance. A German manufacturer promised, however, to remedy the faults mentioned; but it is not yet generally known whether the prospective purchasers and the manufacturer can agree on terms. Manufacturers of motor carriages usually demand one-fourth of the price for thirty days' trial; while the cab owners in question desire free trial before purchase, because they are unwilling to buy such expensive machines without being sure that they are practically useful.

At present, there is only a petroleum-motor carriage and a light motor cycle in Gothenburg, both of French manufacture. I believe there is an American motor carriage in Stockholm; but American manufacturers ought to pay attention, also, to the markets in the other cities of this kingdom, especially Gothenburg and Malmo. It would be of great advantage for American firms to be represented here at once.

Another thing of importance is electrical machinery in general, which will be in great demand as soon as the people have fully learned the value of their numerous waterfalls. A large electric power plant will soon be built at Trollhättan; electric railways and tramways are being planned for Gothenburg, Lund, Bjerröd, and Jönköping. In this line, as in everything else, the Germans are always watchful; they pay close attention to details, and, if necessary, send experts here to study plans, etc., whereby they greatly increase their chances to introduce machinery. If it is not practical for Americans to do likewise, they could possibly employ active agents to represent them here.

Electric-motor carriages are preferred for city traffic. Those with benzine motors are said to be noisy and to emit offensive gases.

Grain Elevator at Amsterdam.—There has recently been completed a grain elevator in Amsterdam, the only one in the Netherlands, says Consul Frank D. Hill, of Amsterdam. It is near the timber harbor; its length is 125 meters (410 feet) and its width 33 meters (108 feet). It was built by the city and leased for a term of fifty-five years at 6,000 florins ($2,400) a year to Messrs. Korthal Altes. For the building itself a space of 2,200 meters (7,218 feet) was reserved. The capacity is from 8,000 to 9,000 lasts (16,000 to 18,000 metric tons); the greater part will be used for the storage of grain in silos; the ground floor alone, with a storage capacity of 1,609 lasts (3,000 tons), being intended for the storage of grain and seeds in bags.

Steam and sailing vessels will be discharged as follows:

The cargo is weighed by hand and put over the ship's side in tipping buckets, which deposit it on the traveling bands. It is then brought to its place by mechanical power. The velocity of transport is calculated so as to insure an easy transfer of all the grain, however fast it may be discharged. A maximum capacity of 200,000 kilogrammes (440,920 pounds) per hour has been fixed, and two kinds of grain may, if necessary, be discharged simultaneously from the same vessel.

The traveling bands run in a channel in front of the building up to its center, where the grain is deposited on transverse travelers that take it to the elevators. These work the grain up to the top of the building, whence it can be conveyed to any chosen division by means of the traveling bands running over the silos.

The emptying of the silos, or bins, is thus conducted: Below the conical bottom of the silos are shafts, through which the grain is transmitted to traveling bands running on the ground floor; it is again raised to the top by the elevators, and thence may be carried off in any desired direction.

If the object is merely to stir the grain, it is taken to one of the top travelers and thrown into another silo; but it may also be sent first through a shaft to the cleaning or weighing machine, and then up again by means of a small elevator to another silo or through a shaft.

The grain can be discharged at the side of the harbor in wagons or lighters at the rate of 100,000 kilogrammes (220,460 pounds) per hour. For damaged grain, silos are arranged in what are called hospital cells.

Oyster Culture in France.—Oysters are a luxury in Europe, says Consul A. W. Tourgee. The natural beds have been exhausted, as the American beds are rapidly becoming, and artificial culture has long been depended upon for a supply of this luscious bivalve. The chief breeding ground in France is the Bassin d'Arcachon, a triangular tidal bay about 9 miles on each side, entirely landlocked and opening out of the Golf de Gascoigne (Bay of Biscay) into the Department of Gironde by a narrow channel about 3 miles in length. The coast is sandy and deserted. A solid forest of maritime pines (Pinus pinaster), hand planted during the present century, has checked the inland march of the sand dunes and protects the basin from the southwest winds which blow fifty out of the fifty-two weeks of each year. The shallow bay is networked with navigable channels, between which at low tide rise the half clay, half sand flats utilized for breeding the succulent mollusk. During the low spring tides, the flats are covered with quantities of a cheap variety of ordinary roofing tile, which has been previously coated with a sort of coarse whitwash. The spawn brought in by high water catches on these tiles, and the lime of the whitewash helps the little mollusk to form his first shell. Toward winter, these tiles are taken up and carefully scraped. The oysters, as large now as one's thumb nail, are spread in flat covered trays, or baskets, of closely woven osier to protect them from the star fish, crabs, and other enemies, and moved nearer the salt marshes on the east side of the basin, to grow. When they have become a little accustomed to an independent existence, they are placed in trenches a little below water level, which are provided with sluice gates, by which they can be flooded at will. They are thus prevented from being chilled in winter or dried up in summer, and are easily protected from enemies, the gates being covered with wire netting of fine mesh; but the primary aim of the gates is to accustom them to being deprived of water—that is, to teach them to keep their valves tightly closed when out of it. In about eighteen months their education in that respect is complete, and they are raked up, barreled, and sent on a journey of several days to the copper rocks at Marennes, France, and to Whitstable, England, to fatten and assume the bilious green tint and brassy flavor demanded by European epicures. About 250,000,000 are shipped annually. The work on the beds is done by bare-footed men and women, both clad in bright crimson knee breeches and sweaters, which render the sexes quite undistinguishable. The regular trenches and dikes, kept in place with spiles interlaced with wattles, look like a Dutch garden.

To one accustomed to the plump, clean, white and gray American bivalve, the flabby, yellow or greenish European specimen is not inviting. The shells are flat, thin, irregular, and as slimy and corrugated as an old barnacle, while the inmates are about the size and thickness of a 50-cent piece for a 5-inch shell. On the spot, they sell from 7 to 10 cents a dozen. Elsewhere, they command more, and the greener, the higher prices. Oysters are never eaten here except on the half shell. A suggestion to put them into soup or patties, to scallop or stew them, shocks a French chef as a proposition to broil a watermelon would a Carolina cook. I think a "pan roast" would be regarded here as little less than sacrilege. Even when by much persistence you have achieved some form of cooked oyster, the chances are infinite that the most noticeable result will be a fit of homesickness caused by regretful memories of the delicious "Blue Points," or succulent "Lynn Haven Bays." It is to be hoped that our oyster men will learn and practice the art of propagating and nourishing the oyster so as to preserve both its superior size and flavor.

Railroads and Street-Car Lines in Siam.—Nearly all of what can be properly termed public works that exist to-day in Siam have been constructed during the last ten years. Prior to that time, only a few canals, a very few streets, and a limited extent of telegraph line existed in the country, says Consul-General Hamilton King at Bangkok.

The construction of railroads began in 1891 although a horse car line had been started in Bangkok in 1889. The first line of railway was about 15 miles in length, narrow gage, and running from Bangkok, the capital, to Pak Nam, the port at the mouth of Menam River. This enterprise is called the Pak Nam Railway Company, Limited, and pays 7 per cent. dividends regularly. The second was the government line, from Bangkok to Korat, a distance of 165 miles. This line, which was begun in 1892 and is standard gage, is now nearly completed and will cost the government nearly $33,000 gold per mile.

All the materials for this line have been manufactured in England, Germany, and Belgium.

A line from Ban Mayee to Chiengmai, a distance of about 400 miles, has been started, and the first division of about 50 miles is under construction. This line will also be standard gage. No manufactured materials to speak of have as yet been purchased for this line.

A line of meter gage (39·37 inches) will possibly be started next year, running to Ratburi, 45 miles, and Petchaburee, 73 miles, from Bangkok toward the Burmese frontier. The survey only is completed, and no materials for construction have yet been ordered.

The King has just granted a franchise to Prince Chow Sai to build 70 miles of light railway from the Menam River to the Nakawn Nayoke River, with several branches.

This passes through a rich rice country, where there is a large population. The King has also a railway programme consisting of lines east and west aggregating more than 500 miles of additional railways; but the revenue of the country is not sufficient to carry out all these works at one time. For this purpose, it is not unlikely that the government may negotiate a loan in the near future.

A private syndicate in 1887 obtained a concession for street-railway lines in Bangkok. These were built for horse cars in 1889 and changed to an electric-trolley system in 1893. This line is crowded with passengers all day long and pays 12 per cent. on the investment.

The rolling stock, machinery, and wire for this road have all been bought in America; the rails in Europe.

It is probable that this line will be extended in the near future, and that another similar system will be built.

American Goods in New South Wales.—I am making every effort to introduce American manufactured goods into this consular district, says Consul F. W. Goding, of Newcastle, N. S. W. A few years ago, no American manufactures could be seen in this city, but now they are displayed in the various shop windows and are well liked.

Some time ago I arranged to have a specimen shotgun sent here, having given the best bank references. A sale of perhaps thirty of the highest priced guns might have been made if the specimen had been sent and had proved to be as represented, but it never came.

At another time I sent an order for about $1,200 worth of rubber goods to an American firm, but my letter remains unanswered. An order for 500,000 envelopes remains open, because the manufacturers have failed to reply to letters addressed to them. It is decidedly disheartening for consuls who are trying their best to bring American goods to the attention of local business men, to find their efforts fail because of the lack of interest at home. It is all the more discouraging when the main portion of letters received by consuls are inquiries made by these firms, who later fail to second our efforts. Even as it is, the increase in the amount of United States goods sold here is something enormous, but it might be much more. If there is any way of letting our exporters know that consular officers would like to have their suggestions followed up, the consular service would be still more valuable to the business interests of the United States than it now is.

Labor in France.—Consul Atwell writes from Roubaix, December 7, 1899:

At a meeting of the labor committee in Paris on December 6 it was decided that eleven hours should constitute the length of the labor day for men, women and children. The resolution was also adopted that three years from the promulgation of the eleven-hour law, the time should be reduced to ten and one-half hours, and six years thereafter to ten hours. For the past month strikes have been going on in the different spinning, weaving and dyeing establishments of Roubaix-Tourcoing. In some cases the demands of the strikers have been granted; in others, the laborers have resumed work under old conditions. Some factories have been compelled to close temporarily, as, in view of the high price of raw material, it was found impossible to accord the increase in wages demanded. There are daily parades of strikers in the streets, without hostile demonstration.

Steel and Iron Rails Wanted in Australia.—Consul Goding writes from Newcastle, New South Wales, November 7, 1899:

There is a great scarcity of steel and iron rails in this colony. Should our manufacturers look into the matter at once, I believe they could secure a large order—perhaps £200,000 ($973,300) worth.

The colonial authorities are very anxious to obtain rails, and, I am led to think, may consider favorably orders from the United States.

The consul desires this notice to have the widest circulation possible, as he regards this as an excellent opportunity for American manufacturers.

German-Uruguayan Commercial Agreement.—Consul Swalm, of Montevideo, under date of October 24, 1899, calls attention to the ratification of the treaty between Uruguay and Germany. The act is in the nature of re-establishing the treaty of 1892, which was denounced in 1897. According to the terms of the agreement, the citizens and the products of each country receive the most-favored-nation treatment in the other country, except that Uruguay is permitted to make commercial arrangements with the countries adjoining, for products that do not compete with those of German origin.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Ferric Oxide Colors.—Chiefly consist of iron sesquioxide, and must contain at least 80 per cent. of this substance. As a general rule, the specific gravity of the powdered pigment is a very good test. Same must not be lower than 4·2. It has been found that the resistance of the pigment to atmospheric influences increases with the specific weight. It was also observed that the color turns out better and more permanent in proportion to the degree to which the temperature is raised in the manufacture.—Farben Zeitung.

Pastes for Labels.—The Seifen Fabrikant publishes the following recipes:

1. Stir 5 parts of rye flour together with 1 part of Venetian turpentine and add enough glue water (size) so that a paste results. This glue dries very slowly, but the paper labels pasted on with it stick very firmly to all metallic surfaces.

2. Gum arabic, 50 parts; glycerin, 10 parts; water, 30 parts; liq. stibii chlorate, 2 parts.

3. Boil rye flour and strong glue water into a mass, to which add 30 parts of good boiled linseed oil and 30 parts of turpentine oil per 1,000 parts. This mixture furnishes a gluing agent which withstands dampness.

4. Dissolve dextrin 2 parts and acetic acid 1 part in 5 parts of water, by heating in a water bath, and add 1 part of alcohol to the solution.

5. Pour 140 parts of distilled cold water over 100 parts of gum arabic and dissolve with frequent stirring. To the solution, which is effected by standing for three days, add 10 parts of glycerin, later 20 parts of diluted acetic acid, and finally 6 parts of aluminium sulphate, and strain through a fine hair sieve.

6. Boil 50 grammes of joiner's glue soaked a day before in cold water with 100 grammes of powdered rock candy and 25 grammes of powdered gum arabic dissolved in water and boiled until the mass flows.

7. According to another recipe, good glue is said to be obtained by dissolving 1 part of powdered sugar in 4 parts of soluble soda-glass.

Absolute Alcohol.—The committee for the compilation of the German Arzneibuch established the following tests for the determination of absolute alcohol:

A clear, colorless, volatile, readily inflammable liquid which burns with a faintly luminous flame. Absolute alcohol has a peculiar odor, a burning taste and does not affect litmus paper. Boiling point, 78·50. Specific gravity, 0·795 to 0·797. 100 parts contain 99·7 to 99·4 parts, by volume, or 99·6 to 99·0 parts, by weight, of alcohol.

Absolute alcohol should have no foreign smell and should mix with water without cloudiness.

Ten c. cm. of absolute alcohol should, after the admixture of 5 drops of silver nitrate solution, not become turbid or colored even on heating.

A mixture of 10 c. cm. of absolute alcohol and 0·2 c. cm. of potash lye evaporated down to 1 c. cm. should not exhibit an odor of fusel oil after supersaturation with diluted sulphuric acid.

5 c. cm. of sulphuric acid, carefully covered, in a test tube, with a stratum of 5 c. cm. of absolute alcohol, should not form a rose colored zone at the surface of contact, even on standing for some time.

The red color of a mixture of 10 c. cm. of absolute alcohol and 1 c.cm. of potassium permanganate solution should not pass into yellow before 20 minutes.

Absolute alcohol should not be dyed, either by hydric sulphide water or by aqueous ammonia.

5 c. cm. of absolute alcohol should not leave behind a weighable residue after evaporation in the water bath. —Lack und Farben Industrie.

Weatherproof Browning of Brass.—The handsome colorings of copper and its alloys, which are based either upon a superficial chemical change or upon the stopping up of the exterior pores with dyeing agents, are exceedingly thin and so little resisting that they are soon destroyed by rainwater. Outside, every alloy only too quickly follows its own way, regardless of the artist's labor. For this reason only such colorings are permanent as are either continually formed again by the caustic substances in the rainwater or cannot be dissolved at all. In case of alloys rich in copper, only the green patina and the well known black patina are self-forming. The handsome green patina is only durable in case it has developed by itself in the course of decades. The green bronzings so frequently seen can but endure the air of the drawing-room. In the open they quickly change into ugly black shades. Alloys rich in zinc, among which brass takes a prominent place, do not admit of being colored in such handsome green or brownish shades as copper, red metal and bronze. Hence, aside from a few insignificant colorings, which are only calculated for temporary appearance, brass would have first to be coppered, which is, as a rule, too troublesome, or else recourse must be had to other mediums, which do not fall in the category of browning. The latter is all the more justified, as the taste of the public at large runs only too strongly on luster and light tones.

The simplest way, therefore, would be to polish the raised portions of the plates bright, imparting a dark shade to the cavities with graphite and similar black substances until a natural blackness results, and to polish off the dirt from the bright places from time to time. If the work of polishing is to be avoided, there only remains the choice between oil paint, nickeling and gilding. In the first case, copal linseed oil varnishes, blond in color or mixed with pigments or bronze, give good results, especially if burned in in the drying stove. Nickeling covers up the pleasant color of the brass entirely, looking almost common on smooth surfaces, but it is the only non-precious metal which remains in unassuming cleanliness. But if art and durability are to be combined, gilding is positively advisable. Same can nowadays be produced so cheaply by electro-plating that the costs do not come too high if the plates are manufactured in a large number and the possibility is considered that by gilding in itself and, if necessary, by the aid of verdigris and sal-ammoniac or liver of sulphur, one is enabled to obtain far handsomer, durable colorings than by the ordinary laborious process of browning, which always looks dull. The public will not object to the increased cost of gilding if the hollows are lightly shaded in an artistic manner with black varnish, and the magnificent color of gold, not obtainable in any other manner, becomes all the more brilliant in the raised positions.—Werkmeister Zeitung.

MISCELLANEOUS NOTES.

Some interesting experiments on the distribution of magnetic induction along a long cylindrical iron rod are described by Dr. C. G. Lamb in The Philosophical Magazine. "When the rod is weakly magnetized, the mean positions of its poles are comparatively near the ends of the rod; with stronger magnetization the poles move farther from the ends; and with very strong magnetization the poles move more and more toward the ends." Dr. Lamb points out that this has important bearing upon the magnetic testing of iron.

American locomotives do not appear to be a success in India, says Sells' Commercial Intelligence. "The Bombay, Baroda, and Central India Company recently purchased some eight or ten locomotives from the Baldwin Works. They turn out to be useless over the whole line, and although cheaper in the first instance than English locomotives, their cost will soon prove much greater in working and repairing. They have to be sent some 319 miles from Bombay to Godhra before they can turn round, because they do not fit the turntables." Then it is time we sold the B., B. and C. I. Company some new turntables.

In answer to a correspondent who asks how to keep frost from window glass, The Pharmaceutical Era says: "The methods usually advised are the employment of double windows or the coating of the glass with glycerin. It is said that a thin coat of glycerin applied to both sides of the glass will effectually prevent any moisture from forming thereon and will stay until it collects so much dust that it cannot be seen through. It has also been recommended as particularly useful to locomotive engineers to prevent the accumulation of steam and frost on their windows during the cold weather. Another very efficient measure is said to be a small fan run by electricity or other power, and so placed as to blow directly upon the glass."

A number of experimental details on the sterilization of water for drinking purposes by means of ozone are given by Weyl in a recent communication (Centr. f. Bak., xxvi., p. 16). Water from the Spree was pumped through a chamber filled with stones by which the suspended matter was strained off. By means of another centrifugal pump the water was pumped into a second cylindrical chamber, 4·5 meters in height and filled with large stones, through which the water trickled and so became finely divided, meeting the stream of ozonized air introduced below. The ozonized water collected in the lower part of this chamber and thence passed to the reservoir. The plant was capable of treating 3·5 to 4 cubic meters of water per hour (800 gallons). The experiments showed that for a good water 1 gramme of ozone per cubic meter (220 gallons) was sufficient, but for a bad water 2 grammes were required for sterilization, the cost being about one-third of a penny per gramme of ozone. The whole of the machinery was driven by electricity.

One of the many uses to which compressed air tools are now applied, is that of quarrying salt which has consolidated while in store. Vacuum pan salt, being of fine grain and containing a large percentage of brine, becomes very hard and compact, so that it is difficult to break it up for packing. Much hand labor with picks was formerly required, but now a firm in Michigan uses a mechanical apparatus which does the work cheaply and easily. The machine, which is illustrated in The Railway Review, consists of a hand truck fitted with a horizontal shaft to which is attached a 10 inch spiral auger, 6 feet long, operated by a Boyer piston air-drill. The operator advances with the truck against the base of the salt wall, and the auger penetrates to a depth of 6 feet in 45 seconds. When a number of these holes are drilled closely together, the section thus undermined falls and breaks up ready for packing. By the use of this machine 2½ days a week, it is found that thirty packers do the work which had previously required sixty, and the work is not nearly so laborious.

The great activity in the German locomotive industry and the impossibility of completing fresh orders within the desired period have induced the Bavarian State Railway Administration to follow the example of certain English railway companies, and order locomotives from makers in the United States. The general director of the Bavarian lines on the occasion of a recent visit to America placed contracts for several locomotives by way of experiment for the German railways, the engines ordered being of the heavy type generally in use across the Atlantic. Two of the locomotives have already been shipped in sections, and delivered at Munich, where the parts have been assembled. The complete locomotives are now being tested in actual work. It is said that, notwithstanding the high freight, the price of the American engines is lower than that of the locomotives obtained from the German works. The Financial Times says that the efficiency of the new engines is very high, but their durability is less, owing to the large use of cast steel in the construction of many parts of the locomotives.

English as the modicum of converse has made rapid progress throughout the civilized countries of the world during the century the last year of which we have started on. On this head a few statistical facts taken from The Journal of Commerce may prove instructive; we quote: "When the century began, these people numbered only 22,000,000, or 16,000,000 less than the people who spoke German, 12,000,000 less than those who spoke French and 10,000,000 less even than those who spoke Spanish. As the century draws to its close, the people who speak English as their mother-tongue number 127,000,000—an increase of 477 per cent. and a greater number than all the people who speak French and German combined. At the end of the last century there were in these United States only 5,000,000 inhabitants; the census with which this one will terminate will hardly show less than 75,000,000. In the same period the population of the United Kingdom has grown from 16,000,000 to 41,000,000, and the colonists of English race have increased from a few hundred thousand to between 11,000,000 and 12,000,000. At the beginning of the century the population of the European continent was 170,000,000. At its close the total approaches 343,000,000. Thus, while at the end of the last century the English-speaking family was outnumbered by the nations of Continental Europe in the proportion of 8 to 1, it is outnumbered by them to-day in the proportion of 2·7 to 1 only."

SELECTED FORMULÆ.

Orange Cider (Orange Wine).—Many of the preparations sold under this name are not really orange ciders, but are varying mixtures of uncertain composition, possibly flavored with orange. The following are made by the use of oranges:

1. Sugar	8	av. pounds.
Water	2¾	gallons.
Oranges	15	

Dissolve the sugar in the water by the aid of a gentle heat, express the oranges, add the juice and rinds to the sirup, put the mixture into a cask, keep the whole in a warm place for 3 or 4 days, stirring frequently, then close the cask, set aside in a cool cellar and draw off the clear liquid.

2. Express the juice from sweet oranges, add water equal to the volume of juice obtained, and macerate the expressed oranges with the juice and water for about 12 hours. For each gallon of juice add 1 pound of granulated sugar, grape sugar or glucose, put the whole into a suitable vessel, covering to exclude the dust, place in a warm location until fermentation is completed, draw off the clear liquid, and preserve in well-stoppered stout bottles in a cool place.

3. Orange wine suitable for "soda" purposes may be prepared by mixing 3 fluid ounces of orange essence with 13 fluid ounces of sweet Catawba or other mild wine. Some sirup may be added to this if desired.—Pharmaceutical Era.

Fixing Bath.—

I.

1. Alum	10	parts.
Water	100	"
2. Sodium sulphite	20	"
Citric acid	3	"
Water	100	"
3. Sodium hyposulphite	40	"
Water	100	"

To use, mix 3 parts of No. 1 with 3 of No. 3 and 1 of No. 2. In this mixture, citric acid tends to prevent the formation of the precipitate which often forms in the alum hypo fixing bath.

II.

Sodium hyposulphite	4	ounces.
Chrome alum	¼	"
Sodium acid sulphite	½	"
Water	1	quart.

Dissolve the hypo, add the chrome alum, then filter and add the acid sulphite. Evaporation of the bath is prevented by keeping the dish covered when not in use.

COMBINED TONING AND FIXING BATH.

Water	32	fl. ounces.
Sodium hyposulphite	8	"
Ammonium sulphocyanide	1	"
Sodium acetate	½	"

Mix, and add—

Water	8	fl. ounces.
Gold chloride	15	grains.
Ammonium chloride	30	"

Add to the solution 100 grains of silver chloride or some scraps of untoned paper, spoiled prints, etc.

For toning alpha paper, developed with ferrous oxalate, the following combined toning bath is given:

Water	10	fl. ounces.
Sodium hyposulphite	2½	"
Sodium acetate	½	"
Ammonium sulphocyanide	¼	"
Gold chloride	4	grains.

A great variety of tones can be obtained, these being principally dependent upon the amount of exposure given to the print previous to developing.—Pharmaceutical Era.

Boiler Compounds.—Boiler compounds and purges, as viewed by the traveling engineer, were treated of in a committee report presented to the recent convention of the Traveling Engineers' Association. The conclusions of the committee were as follows:

1. The committee recommend the use of soda ash as a boiler compound, as it has the widest range of adaptability to the various incrusting ingredients contained in the feed water. There are a number of other compounds on the market, some possessing merit, but the cost bars their use on the locomotive, while soda ash is cheap and easily obtained, and will give good results when properly handled. Of course there is some water that will require a special compound, but the chemist should be able to decide that. The chemist should analyze the water and decide the amount of the compound to be used. It was found that in water containing from 2 to 4 pounds of incrusting matter to the 1,000 gallons, from 6 to 8 ounces of the compound would keep the minerals in suspension, and in water containing more than this amount of incrusting matter to the 1,000 gallons, from 8 to 16 ounces of the compound will give good results.

2. Boilers should be furnished with at least two good pneumatic blow-off cocks, kept in good working order, and the boilers given a good blowing out, both on arriving and departing from terminals. The amount of soda ash for the trip should be put in at the terminal just before the engine is taken out. In using blow-off cocks on the road, we would recommend that they be used several times each trip and for a few seconds at a time. This will get rid of a large amount of the sediment thrown down by the purge and will prevent boilers from foaming, as we find on investigating cases of foaming that the trouble was caused by poor boiler washing and not using the blow-off cocks properly. Boilers should be inspected every time they are washed out, to see that the purge is keeping them clean and that the sediment and scale thrown down by the purge has not lodged between flues and sheets. There should be at least two flues left out in the center of the flue sheet and washout plugs put in, so the space between flues can be thoroughly washed. We find the average cost of the compound per 1,000 miles is between 25 and 35 cents, and the life of flues has been increased 50 per cent. to 75 per cent. We also find where soda ash is being used, and boiler washing properly attended to, that it is a rare occurrence to have flues leaking on the road, while before soda ash was used, leaking flues and sheets were a continual source of trouble.—Railway Master Mechanic.

TRAVELS IN ABYSSINIA.

IN the Section of Geography at the meeting of the British Association, Captain Welby gave an account of his recent travels in Abyssinia, in the course of which he said that King Menelek's capital consisted merely of an accumulation of huts, with the Palace or Ghebi of the King planted conspicuously on a small hill. The land in the valley was well watered and good, the climate invigorating, and the grazing all that could be desired. But there was no wood. Wood was brought in daily from a distance of 15 miles, and was comparatively the most expensive article in the market. At the time of his arrival in the capital with Captain Harrington, King Menelek was about to march north with an army of 70,000 men, and he traveled with the King. While on the march he was struck with the thorough knowledge these so-called savages displayed of their own individual duties. One Sunday morning, when all were resting, the King with a lavish hand breakfasted his loyal subjects, governors of provinces, generals, and common soldiers alike. The meal mainly consisted of huge legs of raw, quivering beef, the repast being concluded in a most unexpected manner by glasses being handed round and filled with champagne. It was civilization washing away barbarism.

Though his sojourn in this Christian land was short, he could not help feeling convinced that when the Abyssinians had still further tasted the pleasures and profits of the civilized world, they would adopt more of its ways and customs, and it must be remembered that the Abyssinians had in a way lived independently, untouched by European nations and their inventive power, and thus they were, from our point of view, steeped in the most astonishing ignorance; but for all that there lay in them a mint of pluck, energy, and intelligence which was merely waiting for development. The Abyssinian dominion at the present day extended to a far greater extent south than was generally supposed. Some of the tribes who willingly bore the collar of subjection were apparently contented and well fed, while others, whose spirits were too elevated for subjection, had an opposite existence.

Those who relied for food solely on milk and meat were of finer physique than those favored with cereals as well, while those dependent on fish and vegetables were, as a rule, miserable looking. Furthermore, they dispelled the idea that fish was productive of a plethora of brains. Captain Welby said that a couple of days south of the capital they came to the sacred hill of Zaguala, on the summit of which he discovered a lake said to be of unfathomable depth. Looking from the summit of this hill, he viewed the distant lake of Zouei, the first of a chain of three lakes connected by running streams. The water of the first he described as good and fresh, of the second as brackish but drinkable, and of the third as highly offensive to the palate. On the banks of the first two lakes were tribes living in a very poor way, but on the third was an independent tribe, which had never, so far as he knew, been visited by any white man. They evidently took him and his Somali companions for an Abyssinian party, and had not darkness come to his assistance he must have fared badly. Other tribes in the district displayed both friendship and hospitality.

After crossing a belt of beautiful, though waterless, land, he entered the country of the Walamo, a people credited with the power of transferring the feelings and behavior of a devil into the body of the stranger. Two theories had been suggested to him of the strange feelings experienced in this country. First, that the body was affected by the water of the district, which was probably impregnated by metals; secondly, as to the mental effects; it had been suggested that, without being aware of it, he was eating his meal before these people under a great mental strain; but the argument was rather beyond him. Further south lay the most picturesque district he had visited. He found hills nearly 11,000 feet high, some clad with slopes of green turf, and others with thick wood. From one of these high-lying camps another chain of beautiful lakes was seen, on the shores of which there existed a mark to commemorate the spot where Sacchi, the friend and doctor of Botego, was killed. Dropping into the plains, he steered for Lake Rudolph, or, more properly, Lake Gallop, where his escort of Abyssinian soldiers left his expedition to their own devices, their place being taken by 30 head of cattle, presents from the Abyssinians.

Shortly before this he had come across a tribe called the Asilli. They always asked him for rain, as they entertained the notion that whenever thunder took place a white man was born, and thus the white man must always be able to bring rain. Probably they believed this because they had never seen a white woman. The western shore of Lake Gallop was a pleasant and inviting land, with an abundance of game, both fish, fowl, and meat. The climate was good and the scenery various. At this time the baggage animals were dying at an alarming rate from anthrax, and instead of eating their cattle they turned them into beasts of burden. Some travelers, he was told, adopted the plan of cutting steaks from the living animal, but they had no need to test this economical plan.

From the southern end of the lake they struck a westerly course into the unknown before steering north again for the outlying Soudan post of Nasser, on the river Sobat, some 180 miles from its junction with the White Nile. During the journey of over 700 miles they discovered two sources of the Sobat, and came into contact with many more tribes, with all of whom they established a friendly feeling, the most interesting tribe met with being a race of giants. These savages stood in many instances 7 feet high. They wore rings of iron round their arms and necks, sometimes of such a ridiculous height that the head could only be moved slightly to the right or left. The hair hung over the shoulders to the waist, being further lengthened by the addition of a long stick resembling a tail. The end of the hair was turned up and formed a receptacle for knick-knacks. They carried two spears and a sleeping pillow, and, like most savages, had no desire to stand before the camera.

New Duties in Venezuela.—Minister Loomis telegraphs from Caracas, January 6, 1900:

Venezuela to-day imposes extra emergency duty on many articles—flour, 1⅙ cents per pound; butter, 6 cents, etc.

NEW BOOKS

Accumulators. How Made and Used. An Elementary Handbook for the use of Amateurs and Students. Edited by Percival Marshall. 12mo, cloth, 80 pages, 40 illustrations. New York, 1899 .... $0 50

Agriculture. Principles of Agriculture. A Textbook for Schools and Rural Societies. By L. H. Bailey. 16mo, cloth, 300 pages, illustrated. New York, 1899 .... $1 25

Air-Brake Catechism. For Firemen, Engineers, Air-brake Instructors, Shop Men, and all branches of Railroad Men. By Robert H. Blackall. 12mo, cloth, 240 pages, illustrated. New York, 1899 .... $1 50

Alaska and the Klondike. A Journey to the New Eldorado, with Hints to the Traveler and Observations on the Physical History and Geology of the Gold Regions, the Conditions of and Methods of Working the Klondike Placers, and the Laws Governing and Regulating Mining in the Northwest Territory of Canada. By Angelo Heilprin. Fully illustrated from photographs and with a map of the gold regions. 12mo, cloth, 315 pages. New York, 1899 .... $1 75

Astronomy. The Elements of Practical Astronomy. By W. W. Campbell. Second edition revised and enlarged, 8vo, cloth, 264 pages. New York, 1899 .... $2 25

Birds. A Dictionary of Birds. By Alfred Newton, assisted by Hans Gadow, with contributions from Richard Lydecker, Charles S. Roy, and Robert W. Shufeldt. 8vo, cloth, illustrated, 1,088 pages. London $5 00

Birds. The First Book of Birds. By Mrs. Harriet Mann Miller. With 8 colored and 12 plain plates, and 20 figures in the text. 12mo, cloth, 149 pages. Boston, 1899 .... $1 00

Botany for Beginners. By Ernest Evans. 16mo, cloth, 220 pages. New York, 1899 .... $0 75

Building Construction and Superintendence. By F. E. Kidder. Part II., Carpenter's Work. Second edition, 8vo, cloth, 544 pages, 524 illustrations. New York, 1899 .... $4 00

Cement. Portland Cement. Its Manufacture, Testing and Use. By D. B. Butler. 8vo, cloth, 360 pages, 85 illustrations. London, 1899 .. $6 00

Chemistry. The Arithmetic of Chemistry. Being a simple treatment of the subject of Chemical Calculations. By J. Waddell. 12mo, cloth, 133 pages. New York, 1899 .... $1 00

Chemistry. Descriptive General Chemistry. A Textbook for Short Course. By S. E. Tillman. 8vo, cloth, 429 pages. New York, 1899 .... $3 00

Clay Modelling for Schools. A Progressive Course for Primary Schools and Grammar Grades. By Anna M. Holland. 8vo, cloth, illustrated, 21 pages, 19 plates. Boston, 1899 .... $1 00

Cyanide Process. Practical Notes on the Cyanide Process. By F. L. Bosqui. 8vo, cloth, illustrated, 201 pages. New York, 1899 .. $2 50

Decorative Designs of all Ages, for all Purposes. With numerous engravings and diagrams. Edited by Paul N. Hasluck. 16mo, cloth, 160 pages. London, 1899 .... $0 50

Dams. The Design and Construction of Dams, including Masonry, Earth, Rock-Fill, and Timber Structures. Also the principal types of Movable Dams. By Edward Wegmann. Fourth edition, revised and enlarged. Quarto, cloth, 250 pages of text, 88 folding plates. New York, 1899 .... $5 00

Electrotyping. A Practical Treatise on the Art of Electrotyping by the latest known methods. Containing historical review of the tools and machinery required, and complete instructions for operating an Electrotyping plant. By C. S. Partridge. 12mo, cloth, 140 pages, illustrated. Chicago, 1899 .... $1 50

Engineer's Handy-Book. Containing Facts, Formulæ, Tables and Questions on Power. Its Generation, Transmission and Measurement, Heat, Fuel and Steam, the Steam Boiler and accessories, Steam Engines and their parts, the Steam Engine Indicator, Gas and Gasoline Engines, etc., etc., etc. By Stephen Roper. Fifteenth edition, revised and greatly enlarged by E. R. Keller and Clayton W. Pike. 12mo, 844 pages, leather pocketbook form. Philadelphia, 1899 .... $3 50

Fertilizers. The Source, Character and Composition of Natural, Homemade and Manufactured Fertilizers, and suggestions as to their use for different crops and conditions. By E. B. Voorhees. 12mo, cloth, 335 pages. New York, 1899 .... $1 00

Fields, Factories and Workshops; or, Two Sister Arts, Industry and Agriculture. By P. Kropotkin. 8vo, cloth. New York, 1899 .... $3 00

Foundry Cupola. The Cupola Furnace; a Practical Treatise on the Construction and Management of Foundry Cupolas. By E. Kirk. 12mo, cloth, 361 pages, illustrated. Philadelphia, 1899 .... $3 50

Heat for Advanced Students. By Edwin Edser. 12mo, cloth, 470 pages, fully illustrated. London and New York, 1899 .. $1 00

Heat and Heat Engines. A study of the principles which underlie the mechanical engineering of a power plant. By F. R. Hutton. 8vo, cloth, 553 pages, illustrated. New York, 1899 .... $5 00

Hop. The Hop, its Culture and Cure; Marketing and Manufacture. A practical handbook on the most approved methods in growing, harvesting, curing, and selling Hops, and on the use and manufacture of Hops. By Herbert Myrick. Profusely illustrated, 12mo, cloth, 299 pages. New York, 1899 .... $1 50

Hydraulic and Placer Mining. By E. B. Wilson. 12mo, cloth. New York, 1899 .... $2 00

Indicating the Refrigerating Machine. The Application of the Indicator to the Ammonia Compressor and Steam Engine; with practical instructions relating to the construction and use of the Indicator, and reading and computing Indicator Cards. By G. T. Voorhees. New York, 1899 .... $1 00

Insects. Our Insects, Friends and Foes. How to Collect, Preserve, and Study Them. By Belle S. Cragin, A.M. With 255 illustrations, 377 pages, 8vo, cloth. New York, 1899 .... $1 75

Insects. Their Structure and Life. A Primer of Entomology. By George H. Carpenter. 12mo, cloth, 404 pages, 189 illustrations. London, 1899 .... $1 75

Kinematics of Machinery. By John H. Barr. 8vo, cloth, 213 figures, 247 pages. New York, 1899 .... $2 50

Landscape Gardening. How to Plan the Home Grounds. By S. Parsons, Jr. With illustrations, 12mo, cloth, 249 pages. New York, 1899 .... $1 25

Landscape Gardening. Treatise on the General Principles Governing Outdoor Art; with sundry suggestions for their application in the commoner problems of gardening. By F. A. Waugh. Illustrated, 12mo, cloth, 152 pages. New York, 1899 .... $0 50

Lead. The Metallurgy of Lead and the Desilverization of Base Bullion. By H. O. Hofman. Fifth edition, revised, rewritten, and enlarged, 8vo, cloth, 559 pages, illustrated. New York, 1899 .... $6 00

Locomotive Engineering. A Manual of Locomotive Engineering, with an Historical Introduction. A Practical Text-book for the use of Engine Builders, Designers, and Draughtsmen, Railway Engineers, and Students. By Wm. F. Pettigrew. With a section on American and Continental Engines by Albert F. Ravenshear. With 9 plates and 280 illustrations. 8vo, cloth. Philadelphia, 1899 .... $6 50

Machine Design. Part II. Form, Strength, and Proportions of Parts. By Forrest R. Jones. 8vo, cloth. 333 pages. Illustrated. New York, 1899 .... $3 00

Mathematics. First Course in Mathematics. (The Home Study Circle.) Edited by Seymour Eaton. Mechanics' Bids and Estimates, Mensuration for Beginners, Easy Lessons in Geometrical Drawing, Elementary Algebra, A First Course in Geometry. From the Chicago Record. 12mo, cloth. 340 pages. Illustrated. New York, 1899 .... $1 00

Metallurgy. Handbook of Metallurgy. By Dr. Carl Schnabel. Translated by Henry Louis. In two volumes. 8vo, cloth. 1,602 pages. 927 illustrations. London, 1899 .... $10 00

Modern Mechanism. A Resume of Recent Progress in Mechanical, Physical, and Engineering Science. By Charles H. Cochrane. New and enlarged edition. Illustrated. 12mo, cloth. Philadelphia, 1899 . $1 50

Naval Architecture. A Textbook of Theoretical Naval Architecture. By E. L. Atwood. 12mo, cloth. 295 pages. Illustrated. London and New York, 1899 .... $2 50

Optics. A Treatise on Photographic Optics. By S. R. Cole. 8vo, cloth, illustrated, 320 pages. New York, 1899 .... $2 50

Photography. Amateur Photography. A Practical Guide for the Beginner. By W. I. Lincoln Adams. 12mo, cloth, 135 pages, illustrated. New York, 1899 .... $1 25

Picture Framing. Mounting and Framing Pictures. With 240 engravings and diagrams. Edited by Paul N. Hasluck. 16mo, cloth, 160 pages. London and New York, 1899 .... $0 50

Plants. A Textbook of Plant Diseases Caused by Cryptogamic Parasites. By George Massee. 12mo, cloth, 458 pages, fully illustrated. London, 1899 .... $1 75

Plant Relations. A First Book of Botany. By John M. Coulter. 12mo, cloth. New York, 1899 .... $1 25

MUNN & CO., Publishers,
SCIENTIFIC AMERICAN OFFICE,
361 Broadway, New York.

THE
Scientific American Supplement.
PUBLISHED WEEKLY.
Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers, 361 Broadway, New York.

TABLE OF CONTENTS.

Automobiles

The SCIENTIFIC AMERICAN for May 13, 1899, is devoted mainly to illustrations and detailed descriptions of various types of horseless vehicles. This issue also contains an article on the mechanics of the bicycle and detailed drawings of an automobile tricycle. Price 10 cents.

The following copies of the SCIENTIFIC AMERICAN SUPPLEMENT give many details of Automobiles of different types, with many illustrations of the vehicles, motors, boilers, etc. The series make a very valuable treatise on the subject. The numbers are: 732, 979, 993, 1053, 1054, 1055, 1056, 1057, 1058, 1059, 1075, 1078, 1080, 1082, 1083, 1099, 1100, 1113, 1122, 1178, 1195, 1199, 1206, 1210. SUPPLEMENT No. 1229 contains a highly interesting article giving full data as to operating costs of horse and electric delivery wagons in New York city. Price 10 cents each, by mail. For sale by all newsdealers, or address

MUNN & CO., Publishers,
361 Broadway, - - - New York City.

BUILDING EDITION
OF THE
SCIENTIFIC AMERICAN.

Those who contemplate building should not fail to subscribe.

ONLY $2.50 A YEAR.

Semi-annual bound volumes $2.00 each, yearly bound volumes $3.50 each, prepaid by mail.

Each number contains elevations and plans of a variety of country houses; also a handsome

COLORED PLATE.

SINGLE COPIES - - - - 25 CENTS EACH.

MUNN & CO., 361 Broadway, New York

PATENTS!

MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine improvements, and to act as Solicitors of Patents for Inventors.

In this line of business they have had over *fifty years' experience*, and now have *unequaled facilities* for the preparation of Patent Drawings, Specifications, and the prosecution of Applications for Patents in the United States, Canada, and Foreign Countries. Messrs. Munn & Co. also attend to the preparation of Caveats, Copyrights for Books, Trade Marks, Reissues, Assignments, and Reports on Infringements of Patents. All business intrusted to them is done with special care and promptness, on very reasonable terms.

A pamphlet sent free of charge, on application, containing full information about Patents and how to procure them; directions concerning Trade Marks, Copyrights, Designs, Patents, Appeals, Reissues, Infringements, Assignments, Rejected Cases, Hints on the Sale of Patents, etc.

We also send, *free of charge*, a Synopsis of Foreign Patent Laws showing the cost and method of securing patents in all the principal countries of the world.

MUNN & CO., Solicitors of Patents,
361 Broadway, New York.
BRANCH OFFICES.—No. 625 F Street, Washington, D. C.